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OFFICIAL PROCEEDINGS

RAILWAY CLUB OF PITTSBURGH

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ELECTRIFICATION AND THE RAILROADS IN THE PITTSBURGH DISTRICT

By FRANK R. PHILLIPS, President of Philadelphia Company

OFFICIAL PROCEEDINGS
OF

The Railway Club of Pittsburgh

Organized October 18, 1901

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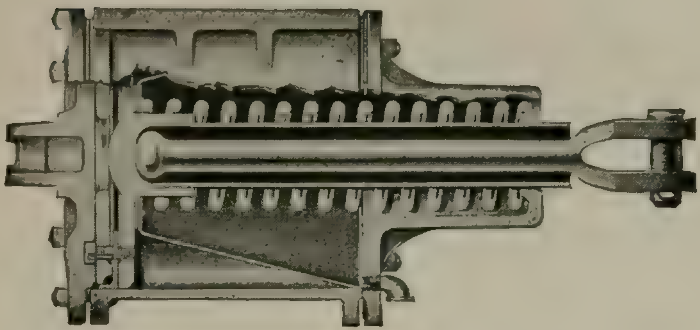

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OF
The Railway Club of Pittsburgh
Organized October 18, 1901

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Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING
NOVEMBER 19, 1931

The meeting was called to order at the Fort Pitt Hotel at 8 o'clock p. m., with President J. E. Hughes in the chair.

The following gentlemen registered:

MEMBERS

Aaron, Paul S.
Adams, W. A.
Allinger, N. J.
Altsman, W. H.
Ambrose, W. F.
Arnold, J. J.
Baer, Harry L.
Bald, E. J.
Balzer, C. E.
Bell, Dan H.
Buffington, W. P.
Burnette, G. H.
Campbell, J. E.
Carlson, L. E.
Carson, John
Chilcoat, H. E.
Christy, F. X.
Conway, J. D.
Coombe, A. B.
Crawford, D. F.
Crenner, J. A.
Dalzell, W. E.
Dambach, C. O.
Dempsey, P. W.
Diven, J. B.
Downes, D. F.
Dunbar, Harold F.
Durkin, James E.
Edwards, C. H.
Emery, E.
Endsley, Prof. Louis E.
Falkner, A. J.
Fenton, H. H.
Fitzgerald, T.
Fleck, John S.
Flinn, R. H.
Frauenheim, A. M.
Fry, L. H.
Freshwater, F. H.
Gardner, George R.
Gatfield, Philip A.
Gellatly, W. R.
Gilg, Henry F.
Glaser, J. P.
Goda, P. H.
Gorman, Charles
Grieve, Robert E.
Guinnip, M. S.
Haller, C. T.
Haller, Nelson M.
Hancock, Milton L.
Hansen, William C.
Herrold, A. E.
Hilstrom, A. V.
Holmes, E. H.
Honsberger, G. W.
Hood, C. E.
Hughes, John E.
Irwin, R. D.
Johnson, A. B.
Kelly, L. J.
Kirk, W. B.
Kroske, J. F.
Kruse, J. F. W.
Kummer, Joseph H.
Lanahan, J. S.
Landis, William C.
Lobez, P. L.
Longdon, C. V.
Ludgate, B. A.
Lynn, Samuel
Masterman, T. W.
Mayer, L. I.
Meinert, Henry
Mercer, B. F.
Miller, J.
Misner, George W.
Mitchell, Frank K.

Mitchell, W. S.
Moody, M. R.
Moore, D. O.
Morgan, A. L.
Morgan, Homer C.
Mycoff, George H.
McAbee, W. S.
McIntyre, R. C.
McKenzie, Edward F.
McKinley, A. J.
McKinley, John T.
McLaughlin, H. B.
McNelty, A. P.
Nash, R. L.
Nelson, W. M.
O'Leary, J. J.
O'Sullivan, J. J.
Pickard, S. B.
Pringle, H. C.
Rankin, B. B.
Robinson, J. M.
Saltic, Thomas
Sattley, E. C.
Schrader, A. P.
Schrecongost, C. P.
Seiss, W. C.
Sharp, H. W.
Sheets, H. E.
Smith, R. W.
Snyder, F. I.
Stamets, William K.
Stephen, James
Stevens, L. V.
Stevens, R. R.
Stoecker, J. P.
Stucki, A.
Sutherland, Lloyd
Tate, M. K.
Thomas, H. N.
Thomas, Theodore
Tipton, G. M.
Van Blarcom, W. C.
Van Wormer, G. M.
Watt, Herbert J.
Wheeler, C. M.
Wikander, Oscar R.
Wildin, G. W.
Winslow, S. H.
Woodward, Robert
Wright, John B.
Wurts, T. C.
Yarnall, Jesse

VISITORS

Barber, M. H.
Boyce, W. H.
Burns, Robert J.
Cooke, M. W.
Davis, R. M.
Donley, J. B.
Douglas, W. R.
Dunham, C. W.
Finley, Charles A.
Fry, C. A.
Germerodt, Howard
Gollmer, H. C.
Goodwin, Arthur E.
Hail, J. H. B.
Hayes, Sidney J.
Heer, Walter
Higgs, Samuel
Homer, W. M.
Hughes, W. W.
Justus, I. J.
Kerr, Charles, Jr.
Keys, R. H.
King, W. R.
Leschke, A. H.
Lewis, S. B.
Menaglia, V. A.
Miller, Ted
Mitchell, Paul L.
Murphy, W. E.
McCaughan, James
Nock, J. C.
Pittenger, C. N.
Reeve, F. J.
Reithel, B. H.
Schneider, O. E., Jr.
Schoch, A. J.
Scott, Harry B.
Shepard, F. H.
Smith, Sion B.
Stanley, H. D.
Stearns, William G.
Stone, E. C.

Varley, E. E. Weiblinger, A. T.
Wolf, Joseph

Preliminary to the meeting a very enjoyable musical program was given by the Triangle Quartette of the Philadelphia Company, composed of the following gentlemen:

Regis Reagan, First Tenor
Joe Poole, Second Tenor
Jack Smalley, Baritone
Joe McGowan, Bass
Al. T. Weiblinger at the Piano

PRESIDENT: Will the representatives of the Philadelphia Company present in the audience please stand? We want to see how many are here, and get to know you. On behalf of the newly elected officers, and also the total membership of the Railway Club of Pittsburgh, I extend to you our sincere appreciation for this wonderful entertainment on this our inaugural evening.

The roll call will be dispensed with as we have a complete record of the attendance on the registration cards.

The minutes of the last meeting are in print and will reach you in due time, if there are no objections we will dispense with the reading of the minutes at this time.

I will ask the Secretary to read the list of applicants.

SECRETARY: The list is unfortunately short and I fear some of the members are not living up to their opportunities as members in presenting the advantages of membership in the Club to their eligible friends:

Balbaugh, John G., Sales Engineer, Pittsburgh Valve Foundry & Construction Company, 26th Street & A. V. Ry., Pittsburgh, Pa. Recommended by Lloyd Sutherland.

PRESIDENT: This application will be referred to the Executive Committee in accordance with our By-laws and upon approval by them the gentleman will become a member without further action of the Club.

If there is no further business to come before the Club at this time, we are up to the address of the evening. I am very sorry to have to announce that on account of an unexpected call out of the city, Mr. Frank R. Phillips, President of the Philadelphia Company, who was to have addressed the Club, is unable to be here. However he has sent a worthy substitute

in the person of Mr. E. C. Stone, Assistant to the President and he will present the subject.

MR. E. C. STONE: Your President has told you the reason for the absence of Mr. Phillips. Mr. Phillips wished me to express to you his very sincere regret at his inability to be present. Having been in the railroad game himself for a good many years, he was especially desirous of meeting with you gentlemen here in the discussion of a subject of such vital interest to the railroads, to the utilities and to the general public.

Mr. Phillips had prepared the paper before he was called away, and I will present it as best I am able.

ELECTRIFICATION AND THE RAILROADS IN THE PITTSBURGH DISTRICT

By FRANK R. PHILLIPS,
President of Philadelphia Company

Although not a railroad man, the subject of electrification in the Pittsburgh District is one in which I am keenly interested. First, as a citizen of the community and as such anxious to assist in the furtherment of any project that will develop the district; and second, and more directly, as the head of the local light and power company. In this latter respect my interest is due to the hope that when electrification does come, the power will be supplied by the Duquesne Light Company. This hope, however, is not entirely selfish, for I believe that the use of central station service by the railroads for electrification purposes will prove not only profitable for the light and power company itself, but also economical for the railroads, and beneficial to the community as a whole.

In order to develop this thesis I intend at this time to review briefly the fundamental conditions which justify or necessitate electrification; consider the extent to which these conditions exist in the Pittsburgh District; outline in a few words the results that have been obtained through electrification in other similar territories; and, finally, discuss the question of power supply; that is, should the railroads in this district, when they electrify, generate and distribute their power requirements, or should they depend upon the electric light and power companies to furnish their needs.

The first electrification of a steam railroad in this country

was made in 1895 when the Baltimore and Ohio electrified the Baltimore Tunnel and the New Haven began electric operation of its Nantasket Beach Branch. During the next ten years no other electrifications of importance were undertaken, but since 1905 there has been rather consistent progress with the sole exception of the war and immediate post war periods. During the past eight years the work of electrification has been progressing at the rate of about two hundred track-miles per year and, as a result, there are approximately 1900 route-miles and 4400 track-miles of electrified roads in the United States at the present time, scattered among some twenty-two of our major railroad systems.

What are the fundamental conditions which justify or, in some cases, necessitate electrification? For our purposes the reasons for electrification may be classed as civic and economic. The economic reasons are naturally the more important and, in most cases, the controlling ones.

The civic justifications for electrification are the elimination of smoke or reduction in noise; conditions which only rarely assume proportions serious enough to warrant electrification for these reasons alone. In some cases, however, railroads have been confronted with legislation along these lines which has left them no alternative other than to electrify. The New York Central's electrification program on the West Side of Manhattan Island is a case in point.

Closely related to these reasons are the instances where underground construction or tunnels become necessary either to enter terminals, shorten the line, or reduce grades or curvature. When this is the case, electrification is again frequently the only solution. In the case of underground construction at terminals, the reasons may be partly civic and partly economic. In the case of tunnel construction at other points, the reasons are purely economic and should be considered on that basis.

The strictly economic reasons for electrification may be classified under three headings. First, where the electrification permits the accomplishment of some necessary improvement for a smaller investment than any other scheme; second, where it results in operating economies that more than offset the fixed charges on the money expended; and third, where it increases revenue to an extent sufficient to justify the investment.

In any given case the economic justification for electrification will, in all probability, be some combination of the three,

for few actual problems are so simple that they fall definitely into any single classification that may be set up.

Probably the most common necessary improvement that may be made for a smaller investment by means of electrification, is the relief of congestion at terminals.

Nearly every railroad system entering a city of any size has its terminal located as near as practicable to the center of business activities. Consequently it is often true that real estate prices in the vicinity of the terminal, combined in some cases with topographical limitations, make the expansion of terminal facilities prohibitively expensive. This, along with the fact that terminal electrification usually includes a certain amount of suburban electrification, with an accompanying increase in revenue and reduction in expenses, together with the further fact that the density of traffic at terminals is ordinarily sufficiently high to keep unit cost figures within economic limits, indicates that electrification rather than expansion will increasingly become the answer to this important problem.

The importance of terminal electrification from the standpoint of suburban or commuter traffic must not be overlooked. Under present day conditions successful suburban service demands electrification. The traffic densities are too great to permit of satisfactory service with steam locomotives. The use of multiple-unit trains has been found to increase the capacity of stub terminals from 30% to 50%, while with through terminal or loop stations the increase in capacity may be even greater. With multiple-unit electric trains most of the problems involved in locomotive operation at the terminal are entirely absent, with the result that the capacity of the tracks is increased to a very marked extent.

In the same general category is the case where congestion on through routes, resulting from a large volume of traffic on heavy grades, must be relieved. Here again the problem is an economic one. Which will result in the lowest overall cost—the construction of additional main tracks, or electrification with its high speeds and greater loads? Again the answer is frequently electrification, particularly when the factor of operating economy is taken into consideration.

This, then, brings us to the next economic reason for electrification, namely, operating economy. I believe no one will dispute the fact that electric operation invariably results in a marked saving in operating expense. With respect to fuel, locomotive maintenance, and wages, as well as other smaller items

such as water, lubricants and the like, there seems to be a wide margin in favor of the electric locomotive for trunk line service. In fact, the figures are quite amazing. According to a report presented before the World Power conference in Berlin a little over a year ago, the combined operating costs on four major trunk line railroads were reduced from $8,900,000 for steam operation to $4,200,000 for electric operation (the figures of course being adjusted to make them comparable), a saving of 53%.

In addition to these direct savings there are still others, which, though difficult to evaluate, are quite real. The more efficient use of rolling stock, the release for revenue traffic of equipment formerly used for the transportation of locomotive fuel, the reduction in damage claims by reason of closer adherence to schedules, are other factors of importance.

Even so, it is probably true that not very many electrifications have been made on the basis of operating savings alone. On the other hand, it is not hard to see that where other considerations make electric operation desirable, the reduction in expenses will tip the economic scale in its favor.

The third economic reason for electrification is increased revenue. This aspect of the problem ordinarily assumes major importance only in the case of suburban or commuter traffic, which, as has been shown above, may be electrified both to reduce congestion at terminals and to save in operating costs. The possibility of increasing revenues by providing electrified suburban service can very well be the controlling factor in the determination of whether or not terminal facilities and short sections of the main line should be electrified. Striking examples of this are the recent electrification of the Reading Railroad in and around Philadelphia and the electrification of the Illinois Central at Chicago.

After 1920 the suburban passenger business of the Reading Railroad into Philadelphia faced severe competition from automobiles, new subways, a competing electrified railroad and bus lines, all of which resulted in a severe loss of traffic to the railroad. In view of the foregoing the Reading Company was faced with two alternatives: either to continue steam operation with decreasing traffic and earnings, with the only means of cutting the cost of operations being to reduce the number of trains, thus further hampering the service; or to provide a modern, superior service by means of electrification. As you well know, the second alternative was adopted. While the new service has

not been in operation for a sufficient length of time to furnish conclusive results, there is every indication that electrification has proved in this case to be the answer to a very serious problem.

Probably as good an example as any of the extent to which revenues can be increased by giving the better service in suburban territory which results from the faster, cleaner, and more frequent trains made possible by electrification, is the Illinois Central at Chicago. When this road was electrified in 1926 running times were decreased from 11% to 28% as a result of high maximum speeds and the use of high accelerating and braking rates. In addition, the number of trains was increased immediately by 40%. Within a very few months the service operated at a profit rather than at a loss. Indeed, it is quite apparent that the traveling public will use a clean, fast, and reliable transportation system, the type of transportation system that can only be provided by electric motive power.

In this connection it must not be forgotten that electrified suburban service may be of great benefit to the community. Take for example the case of Philadelphia. When the Pennsylvania electrified its main line a number of years ago, it opened up a territory for some twenty miles to the West of Philadelphia for commuters working in the city. Since then that section has grown remarkably. Following closely on the conversion of this road, the Chestnut Hill Branch was electrified, with a quite similar development of the territory served. In general, it can be expected that with electrified suburban service, communities will be developed on the average of 1 to 2 miles apart for a distance of 40 miles from the city, a condition which reacts to the favor of the railroad, in addition to benefitting the community as a whole.

Now let us consider conditions as they exist in the Pittsburgh District and try to decide in a very general way the extent to which we should expect electrification in this territory in the reasonably near future. In order to limit the scope of the discussion and in order to keep within the territory served by the companies with which I am associated, I am going to consider the Pittsburgh District as only that area within a radius of some 30 to 40 miles from the city.

What I say in this connection must not be interpreted as an attempt to analyze the problem of any particular railroad, or as a criticism of any policies adopted or likely to be adopted by any of the various roads serving this District. The proper

solution of problems as complicated as those I have in mind can only be found after extremely detailed studies. Certainly they cannot be answered in a review of the subject as cursory as this one must of necessity be.

The first aspect of the problem is the question of terminal congestion and the possibility of its relief by the expansion of present facilities. In this respect it seems to me that conditions in our territory are peculiarly favorable to electrification. Although every railroad entering Pittsburgh can in all probability expand its facilities to a small extent by the installation of additional tracks, and at the same time keep the investment within reason, the location of the terminals, together with our peculiar topographical conditions, make it seem reasonable to expect that the handling of additional traffic through expansion has very definite economic limits. In other words, it would appear that the extremely high price of real estate, combined with the limitations imposed by the hills, valleys, and rivers, makes very extensive expansion out of the question.

Take for example the three passenger terminals in Downtown Pittsburgh. Both the Baltimore and Ohio and the Pittsburgh and Lake Erie are hemmed in on one side by city streets, which in all probability cannot be relocated, and on the other side by the Monongahela River. Although in each instance there is some room left for the physical expansion of facilities, it seems clear that with any substantial increase in traffic some other means will have to be found to increase terminal capacity. In the case of the Pennsylvania Railroad it is, of course, possible to expand in one direction, as they are now doing, but here it can only be carried so far; and in the other direction the contour of the land is such that no more space for tracks is available.

The same arguments also apply in the case of the main lines leading out of Pittsburgh. Most of them follow either the rivers or the valleys between the hills, which inherently impose many difficulties in the way of constructing additional tracks. Consequently if at any time the freight and passenger traffic in this district reaches the capacity of the main routes, it is very probable that the most economical way of handling the growing needs of the community will be to electrify.

The heavy grades on those roads whose routes do not follow the rivers but more or less run at righ angles to them, also present situations usually favorable to electrification. On electrified roads now in operation in the South and West where

heavy grades are present, much heavier trains are being handled at higher speeds than was thought possible before electric motive power came into the picture, thus substantially increasing the capacity of existing tracks.

Reverting now to the question of suburban traffic, it again seems to me that electrification affords many possibilities in and around Pittsburgh. It does not appear that suburban development in this territory has in any way reached the magnitude that might be expected. There is still plenty of opportunity for the development of communities between, say, Pittsburgh and Greensburg and Pittsburgh and Beaver. Adequate transportation facilities into the city would rapidly bring about this development. There is no question in my mind but that the electrification of the main lines within a radius of some 40 miles of the city would be accompanied by a rapid growth in our outlying communities, which, in turn, would result in a large increase in suburban traffic. After all, from the individual's point of view, time is the important factor, not distance.

As previously stated, this seems to have been adequately proved in other communities. The suburban developments in and around Philadelphia and on Long Island can be largely attributed to the type of service that the raliroads have been able to offer through electrification.

And finally, it would seem that the density of traffic, both passenger and freight, in this territory is sufficiently high to support the investment required for electrification. For any given electrification there is some point of traffic density at which electric operation is justified. I am sure that as far as Pittsburgh is concerned, this point has long since been reached.

The logical conclusion is that the fundamental conditions which justify or necessitate electrification exist here in Pittsburgh, and that therefore before many years have passed, electrification programs will be inaugurated in this territory and conditions now existing in other metropolitan centers will be realized here.

Assuming, then, that we will be confronted before long with the problem of electrification, the question arises as to the method of power supply. Should the railroads provide their own generation and distribution facilities or should they depend upon central station service to meet their requirements?

First and foremost among the requirements of power supply for electrification is continuity of service. If the advantages of electrification are to be realized there must be no failure of the

power supply. In fact, I can think of no type of service requiring a higher degree of dependability than that of an electrified railroad. The failure of power during peak movements would undoubtedly result in utter confusion, and unless schedules can be adhered to, many of the advantages of electric operation immediately disappear.

Next in importance is the question of the cost of power. As we have said before, one of the chief merits of electrification is the reduction in fuel cost, and unless the margin of cost between the fuel used in steam locomotives and the equivalent electric power used in electrified operation is sufficiently great, the operating economies that have been mentioned will not be sufficient to economically justify electric operation.

Other items that must be taken into account when considering power supply are flexibility for expansion, and the uniformity of voltage and frequency. Even though the initial program may contemplate the electrification of only the terminal and short sections of the main line, the possibility of extending the main line electrification in the future must not be forgotten. Any program that is adopted, therefore, must be such that it can be economically expanded without serious difficulty.

From the points of view especially of reliability of service and power costs, central station supply has a distinct advantage over independent generation and distribution of power by the railroad itself. The large power stations of the central station system located at widely separate points, the comprehensive network of transmission lines by which each distribution center receives its power over several different routes, and finally the interconnection between adjacent power systems enable the utility company to provide a degree of reliability in power supply which cannot possibly be equalled in the relatively small power system of the individual railroad. Furthermore, the enormous capacity of the central station power system, compared with the individual demands of even the heaviest trains, make possible a uniformity of frequency and voltage which is a most important factor in successful electrified operation.

From the point of view of cost, the central station has many advantages over the independent system. Of particular importance are the advantages with respect to reserve capacity and diversity of load. Consider, for example, the number and size of generating units to be installed in the power plants. If, for example, the railroads peak demand is 30,000 Kw's, to ensure reliability of service we require the installation of three

15,000 Kw. or two 30,000 Kw. machines, thus necessitating 50% or 100% reserve capacity. Similar proportions of reserve capacity are also required in the transmission system. In present day central station systems, however, the great number of units, both in generators and lines, and the interconnections between them, make it possible to operate with smaller percentages of reserve capacity and at the same time with less probability of interruption.

The diversity of load between the many different classes of power users on the central station system is also a very important element in the economy of power supply for railroad electrification.

If the railroad company owns and operates an independent electric power system, the system must have adequate capacity to safely supply the maximum demand for power although that demand may exist for only a few hours during the year. As already explained, the installed capacity must be substantially larger than the maximum demand in order to provide proper insurance for continuity of service.

If, on the other hand, the railroad electrification load is superimposed upon the load of the central station system, it invariably happens that the maximum requirements of the railroad do not occur at the same time as the peak load of the central station system. The daily peak of railroad requirements will in all probability not exactly coincide with the daily peak of the central station system, and the maximum yearly peak of the railroad may even occur in a different month from the maximum yearly peak of the central station system.

As a result of the effect of diversity each kilowatt of railroad power demand may be supplied from the central station system by a substantially smaller amount of generating and transmission capacity than would be required for an independent power system to supply the railroad.

This reduction in required capacity is never less than 15% and may sometimes run to 35% or 40%.

Another important item of economy in favor of the central station system is found in the very large quantities of power which it generates and distributes. Operating costs for an additional load such as a railroad electrification are to a large extent only increment costs.

Again, the central station system has an established network of transmission lines over the territory which it serves. For the individual railroad the transmission problem is usually

a serious one. Generally the most practical solution is the construction of transmission circuits along the railroad right of way, but this practice has some important undesirable features.

If all sources of power supply follow one route, we know from experience in our business, that even though there is more than one circuit, all may be involved in trouble at one time. In the case of the particular problem we are discussing, this seems to me to be even more probable. A wreck at one point could very well damage all transmission facilities between the generating station and the transformation or conversion points and completely tie up a considerable section of the road. To obviate this it would be necessary to construct additional lines over other routes, but when that is done very difficult rights-of-way problems are likely to be encountered. The Pittsburgh district is worse in this respect than many others. The physical limitations of the contour of the country, together with the density of population in certain areas, makes it extremely difficult to find suitable rights-of-way for high voltage transmission lines. Furthermore, if the railroad, as a matter of precaution and in order to insure dependability of service, were to follow this practice extensively, it would soon find itself duplicating facilities already in existence.

These then are some of the fundamental reasons why we believe that central station power supply will prove more economical and more satisfactory for railroad electrification than will independent power systems owned and operated by the individual roads.

The Duquesne Light Company's physical power system consists of three modern steam generating plants—the Colfax Power Station, the James H. Reed Power Station, and the Brunot Island Power Station. The former is located on the Allegheny River in the Borough of Springdale, approximately 18 miles from Pittsburgh. The latter two are located on Brunot Island in the Ohio River about a mile and a quarter from the Point. The Colfax Plant is within about a mile of a coal mine owned and operated by us. The James H. Reed Plant and the Brunot Island Plant are both supplied normally from our mine on the Monongahela. All plants are provided with storage facilities for several months supply of coal.

These three stations are interconnected by a 66,000 volt high tension transmission ring, which completely surrounds the Pittsburgh District and consists of two or more circuits in parallel. Supplementing this primary ring is another 66,000 volt

ring which extends from Ambridge down through the Beaver Valley district on one side of the river and back again on the opposite side to a point a little north of Ambridge. Located at various points on this 66 kv. ring are 7 large stepdown substations. From these seven substations and the Brunot Island power station, a large number of 22,000 volt and 11,000 volt lines supply the larger industrial customers, and the centers of power distribution throughout the area served.

The entire Pittsburgh area is, therefore, interlaced with 11,000 and 22,000 volt transmission lines served either directly from the generating station bus or from the 66,000 volt ring which interconnects the power stations. The layout of the transmission lines themselves is such that duplicate or loop service is provided throughout, with the result that failure of lines or equipment seldom affects service.

The Duquesne system is interconnected with those power systems which adjoin us. At Colfax there is a 132 kv. interconnection with the West Penn Power Company and at Valley Substation, located near Rochester, Pa., there is a 66 kv. interconnection with the Pennsylvania-Ohio Power Company. At the present time we operate in parallel with the West Penn Power Company system at all times and they in turn operate in parallel with the Ohio Power Company and other interconnected systems. The net result is that all of the major power systems in Pennsylvania and Ohio, as well as some systems in Indiana and the South, totaling more than 1,000,000 kw. capacity, operate normally as one large interconnected network, providing the entire area with an extremely high degree of dependability of service.

Great advances have been made in recent years in prevention of interruptions to service from large power systems. During the year 1930 the average customer on our system served at transmission voltages received service that was 99.987% continuous. In other words, this service was off only 0.013% of the time during the entire year. This, we believe, is as near perfection as could possibly be expected, and what it actually means is that a large majority of our customers did not experience any interruptions at all.

In addition to dependability, electric service to be satisfactory must be free from voltage variations and rendered at a constant frequency. We believe we have accomplished this to as great an extent as any power system in the country. With reference to voltage regulation, we are well in advance of most

companies. The fact that 50% of the energy we sell is sold at high tension voltages to industrial customers and serves the lighting load as well as the power load in the industrial plants, means that our entire transmission system must be maintained within a narrow voltage range. With respect to voltage fluctuations due to abnormal operations we also feel we have gone a long way to keep their effect to a minimum. Without going into the technical details of the subject, I can only say that our system is so laid out and interconnected that the effect of trouble is largely confined to the section in which it originates and that any particular failure is not felt throughout the system as a whole.

Our frequency is regulated within extremely close limits. We have probably gone farther than most companies in the use of automatic frequency control equipment, and our normal variation is kept within the limits of plus or minus 1/10th of 1% of 60 cycles.

It, therefore, appears that the service standards on the Duquesne Light Company system are already adequate to more than meet the needs of railroad electrification.

When the time comes to consider the economic aspects of the problem, the load characteristics of our system with relation to the probable demands of the railroads will be important. At the present time our daily load factor is in the neighborhood of 75% and our annual load factor is approximately 55%. Our daily peak during the period when business is normal occurs ordinarily between 8:30 and 11 in the morning. Our annual peak usually comes sometime during December, January, or February, and once in a long while in either November or March. Our summer peak is some 15% below our winter peak.

These characteristics, I believe, are such that we will be able to provide service to electrified railroads under rather favorable conditions. The maximum railroad freight movements apparently take place in the Spring and Fall of the year, and the maximum passenger movement is in the Summer. At all of these times we have on our system a certain amount of spare generation and transmission equipment which we have had to install in order to take care of our Winter peak. With reference to suburban traffic and our daily load curve, the situation also appears favorable. The peak of suburban movements, of course, occurs between 7:30 and 8:30 in the morning and between 5 and 6 in the evening. As a general rule the peak demands of the railroads at those hours would not superimpose

themselves upon our industrial load and could, therefore, be handled without the installation of facilities equivalent to the demand. Major railroad movements, particularly with reference to passenger traffic, frequently come immediately before or after a holiday. Due to the fact that our load is predominantly industrial, those are periods when our demand is off.

In conclusion, our findings may be summarized as follows:

1. The essential conditions necessary to the successful electrification of railroads appear to be present in the Pittsburgh situation. These are physical and cost limitations to increasing terminal capacity, high density of traffic and adequate supplies of electric power at reasonable cost.

2. Electrification of the railroads in the Pittsburgh district should, therefore, result in a reduction in overall costs of operation, and very probably an increase in revenues from suburban traffic.

3. Power supply from the Duquesne Light Company system will undoubtedly prove more economical than from independent systems owned and operated by the railroads themselves. Duquesne Light Company is in a position to furnish the required service promptly and efficiently.

We conclude therefore that the electrification of our railroads will result in benefits to the community, to the railroads themselves, and to our power company. It seems, therefore, reasonable to expect that electrification in Pittsburgh will become a reality in the not too distant future.

PRESIDENT: Gentlemen, you have heard a very able presentation of a very interesting subject. The paper is now before you for general discussion. We would be glad to hear from anyone who has a thought to present or a question to ask, and I am sure Mr. Stone will be glad to answer any questions you may wish to ask.

MR. E. C. STONE: The question has been raised as to the relative costs of power from Niagara Falls, from the Colfax plant at Pittsburgh, and as delivered to the new Cleveland terminal. A figure of 1.5c per Kw-h applying presumably to a certain user of power in Pittsburgh has been contrasted with a figure of 0.5c per Kw-h stated to be the rate paid by the Cleveland terminal.

The cost of producing power in large power plants at Niagara Falls is extremely low, because of the low cost of the hydro-electric development at that point. Power at the Niagara

Falls plant is in fact produced from water at a lower cost than power is produced from coal at Colfax.

Cost of power to the user, however, includes both cost of production and cost of transmission or delivery. On the average, power from Niagara Falls must be transmitted much further to its market than power from Colfax which, on the average, is utilized at a distance not much more than ten miles from the plant. Because of the shorter transmission distance involved in the utilization of Colfax power as compared with Niagara Falls power, the advantage in production cost at Niagara Falls loses much of its significance.

Flat statements as to rates for electric power in different places and under different conditions are misleading. There is a tremendously wide difference in the conditions under which electric service is supplied to the thousands of customers of the power company. Because of this wide difference, power is being supplied by the Duquesne Light Company under differing conditions at rates varying from 8c per Kw-h all the way down to ½c per Kw-h. When making a comparison of rates in different cities, it is essential that the comparison be made on the basis of like conditions of use. Obviously, the very low rates can be given only to users taking very large quantities of power at very high load factors.

PRESIDENT: I see in the audience Mr. Shepard, of the Westinghouse Electric and Manufacturing Company. We would like to hear from him on this subject.

MR. F. H. SHEPARD*: The paper of the evening was most interesting. Mr. Phillips' statement on the power situation, and for the production and distribution of power, are enlightening and governed by the effective and efficient use of electric investment. The railroads are an essential part of our activities, along with manufacturing and all other transportation. It is quite fitting that the generation and distribution of power should be recognized as a particular activity and, furthermore, that it is ably administered. And as such, there is no reason why all the power for transportation, as well as manufacturing, should not be furnished from an universal supply, for after all, it is the aspiration of every engineer to get the most for a dollar, no matter whose dollar it may be.

There is no question at all that the ideal method for han-

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* Director of Heavy Traction, Westinghouse E. & M. Co.

dling rail traffic, either freight or passenger, is with electric power. Electric power in fact we all know is the ideal for everything that can be done with such power. My reason for this statement is that there is no way of doing anything more flexibly, more easily, or more efficiently, than with electric power. Of course, we do know that we cannot practically utilize electric power for all purposes. It has little warrant if we are required to spend an undue amount of money solely to employ the ideal method of operation.

Now as to the future, some of us believe that the United States are going to get out of the doldrums. We believe that these United States have developed by reason of and along with the railroads, and that the public in time will properly appreciate what rail transportation really means. These United States are not going to stand still—they are going forward. The demands for traffic per capita are more than in any other country in the world, and in the future will be unquestionably greater. We are just now going through a period of transition by reason of the tremendous use of the automobile on public highways. The steel highways are privately owned and supported by the rate structure—the publicly owned hard surfaced highways are directly and indirectly supported by all of us. Do not forget that we are all, even including the railroads, paying for the public highways. Sooner or later, after the period of transition, we will settle down, and a stabilized traffic will prevail. On the hard surfaced highways there will exist the traffic that belongs there; and some of the present traffic will go back to the railroads where it belongs. Most of us who use these hard surface highways are not enthused over the trains that carry heavy traffic over them, sometimes with one or several heavy trailers, and certainly we are concerned about the rather extreme use of these facilities which we all like to enjoy. The rail facilities have created large centers of population and of industry, they serve our large cities and suburban territory, and with capacity and certainty that would be impossible for any trucking service.

As to the future, I consider that we may look forward to the increased use of electric power, to a more intensive use of our railroads by larger trains with higher speeds, both for express passenger and freight service, to the expansion of our local suburban traffic, and to the use of more and still more electric power for these future trains of increased capacity. This will come with the continued development of this country but

only with recognition and support of the railroads so they can obtain the necessary credit to further carry on improvements in service, which you of the Railway Club so well know has been their serious and constant objective.

PRESIDENT: I have an associate here tonight by the name of George H. Burnette, Assistant Chief Engineer of the Pittsburgh & Lake Erie Railroad. Will you stand up so we may know you.

I am also glad to see another transportation man here, Mr. Thomas Fitzgerald. We will be glad to hear from you.

MR. THOMAS FITZGERALD: I could not add anything to the paper. I would like to call attention to the fact that we are very fortunate in having for our speaker a man who has been recognized by the American Institute of Electrical Engineers as one of the foremost engineers in the country. And at the same time we have heard from a man who was in charge of the first electrification of a steam road in the country. Mr. Stone referred to that installation as having been on the Baltimore & Ohio in 1895. Frank Shepard was in charge of the installation. My only claim to a place in the sun tonight is that I rode on the first railroad train pulled by an electric engine in the United States.

PRESIDENT: Professor Endsley, can we hear from you?

MR. L. E. ENDSLEY: I have always been a steam engine man! After going to college I started to study civil engineering. Then I saw a locomotive and changed to mechanical engineering, and I have never been sorry that I did. And I have seen a lot of steam locomotives in this country, and we are going to see them for many years. But we will see some electric locomotives in cities and congested points.

I was told by a shoe dealer in Chicago in 1911 that Chicago would be electrified in five years. I said to him that if that was accomplished in twenty-five years they might be glad. They have one road electrified and it is twenty years.

As to the local situation, the hills are too close and too many people want to live here, and some day we will see Pittsburgh electrified. I do not say how soon it will come. The railroads do not make all the smoke in Pittsburgh. Some manufacturers do not burn coke.

I have enjoyed the paper very much. It is very enlighten-

ing to have a man who knows the subject present a paper like that.

PRESIDENT: It has always been the custom for the newly elected President to call on a gentleman who is always here and who is the only remaining member of the four who originated this Club, Mr. Crawford.

MR. D. F. CRAWFORD: Mr. President, It is of course, a pleasure to acknowledge my part in the formation of the Railway Club of Pittsburgh, my long association and my great interest in its progress and activities.

Mr. Fitzgerald's mention of Mr. Sheppard's and his own experience with the electric locomotive on the Baltimore & Ohio Railroad in 1895, recalls the fact that, I too had the privilege of observing its working a short time after the installation, and in 1896 I visited with Colonel Heft of the New York, New Haven & Hartford the Nantasket Beach Line referred to by Mr. Stone.

Although always interested in the use and development of the steam locomotive, and having participated in the design of several notable examples, my interest in electric traction is evidenced by my membership in the American Institute of Electrical Engineers for thirty-five years, as well, as my participation in the design of some electric locomotives now in use.

We all recognize and appreciate the excellent improvements made in the steam locomotives and appliances, which have so greatly increased the capacity and efficiency, and we may look forward to further progress in this direction. The question of electrification is not one of the mere substitution of electric for steam power, but one requiring consideration of the many factors involved in meeting a specific situation.

From my continued study of the many phases of transportation, I am prepared to say that, I am fully in accord with the general views so ably expressed in the paper presented.

The possibility of obtaining adequate and reliable primary power from several sources, such as, the interconnected plants of the public utilities, will in my opinion tend to hasten the use of electric power by the Railways. By utilizing the existing power plant and transmission system facilities, the Railways avoid the initial expense involved in providing individual plants of capacity sufficient to meet the maximum demand, plus stand-by emergency equipment, and are assured a continuity of operation not obtainable with a less comprehensive system. The

joint interest of the Railway and Power Company will permit agreement on a suitable charge for power.

Some years ago, I was asked to make a definite statement, as to whether or not, the electric motor would supplant the steam locomotive for railway traction. I do not remember the exact words of my reply, but it was to the effect that, there would be many steam and many electric locomotives used, and that the choice of power would be clearly indicated by the traffic and economic conditions existing in each particular situation. Surely the intensive passenger traffic of the New York, New Haven & Hartford Railroad, the entrance of the Pennsylvania Railroad into New York through tunnels under the Hudson River, and the traffic and topographical conditions of the Chicago, Milwaukee & St. Paul Railroad, and those of the Norfolk & Western Railroad are examples of situations where the utility of electric traction could not well be denied.

As main line traffic density increases the connecting together of already electrified suburban zones is logical, and the electrification of the Pennsylvania Railroad from New York to Washington, now under construction, at least points the way to what may be expected.

The development of electric traction in the Pittsburgh or any other territory will be governed by the economic conditions, and these economic conditions include traffic density, track and station facilities, power availability and cost, and probable growth of travel, as has been so fully disclosed by Mr. Stone. I think we are very fortunate in having put before us such a clear and precise statement of the whole situation.

We can conclude I think, that electricity is not going to entirely supplant steam power, but that both steam locomotives and electric traction will be used on the railroads, and that each will indicate very definitely the field of use.

PRESIDENT: Mr. Flinn, have you anything to add?

MR. R. H. FLINN: I rather hoped I would not be called on because I am not in a position to promise electrification in the Pittsburgh District. The author of the paper stated that he did not have any particular railroad in mind, but I cannot escape the idea that he had the Pennsylvania in mind because we are the only railroad in the district that has a very extensive suburban service, and unfortunately for this electrification program we have six or seven different routes over which that service operates and therefore we cannot consider any general

electrification. Probably we will have to start on some one division, and it is no secret to say that we have considered in a more or less general way the west end of the Pittsburgh Division suburban territory, primarily due to the terminal improvements we have in contemplation to relieve our yard operation. I do not know whether it would be economical or not; that can only be determined by a careful study of the details. I have no doubt that electrification will provide a somewhat cleaner and faster service. I cannot agree with the statement that it would be more reliable, as the only element of difference would be the steam locomotive failure vs. power failure and the locomotive is 99.987 in our suburban service, to quote the figures of the paper.

I want to compliment Mr. Stone for the able presentation he has given us and to say that I think the paper is well thought out and I have no doubt that the general principles laid down are the ones that are going to govern the situation. Whether we can save in operation or not, there is no doubt that we have always to pay the depreciation and the interest on the investment and that will be a determining factor in the electric problem. As far as we are concerned, I feel certain that in view of the extensive electrical program we have between New York and Washington, the Pittsburgh situation will have to wait a while.

PRESIDENT: Any one else? Mr. Snyder, Vice President and General Manager, Bessemer & Lake Erie R. R.

MR. F. I. SNYDER: Mr. President, I would not care to make any comment on a technical subject such as this in the presence of all these experts here tonight. It has been a very interesting paper and also the discussion on it. I would like, Mr. President, to move that a vote of thanks be extended to Mr. Phillips, the author of the paper, and to Mr. Stone who has so ably presented and sustained the discussion of it, and that we express out appreciation by a rising vote.

The motion was duly seconded and prevailed by unanimous vote.

SECRETARY: We have heard with a great deal of pride tonight that out good friend Mr. Crawford is the only surviving member of the little group of four who in the first year of this century conceived the idea and developed the organization of the Railway Club of Pittsburgh? Mr. Crawford has served

OFFICIAL PROCEEDINGS

RAILWAY CLUB OF PITTSBURGH

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Vol. XXXI. DECEMBER 17, 1931 No. 2.

PITTSBURGH AND THE RAILROADS

By CURTIS M. YOHE,
Vice-President, The Pittsburgh & Lake Erie Railroad Company

OFFICIAL PROCEEDINGS

OF

The Railway Club of Pittsburgh

Organized October 18, 1901

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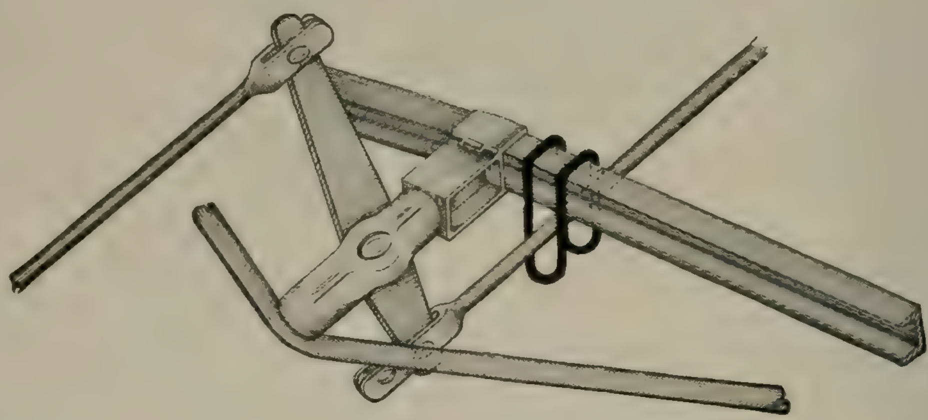

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Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING
DECEMBER 17, 1931

The meeting was called to order at the Fort Pitt Hotel at 8:00 o'clock, P. M., with President John E. Hughes in the chair.

The following gentlemen registered:

MEMBERS

Aaron, Paul
Adams, W. A.
Allison, John
Altsman, W. H.
Anthony, R. H.
Armstrong, Richard
Askin, J. A.
Babcock, F. H.
Balzer, C. E.
Barr, H. C.
Beam, E. J.
Berg, Karl
Berghane, A. L.
Bittner, George
Blair, John R.
Braun, O. F.
Brewer, H. W.
Buffington, W. P.
Bull, R. S.
Burnett, George H.
Callahan, F. J.
Campbell, J. T.
Cannon, T. E.
Carmack, J. L.
Carr, T. W.
Carson, John
Cassiday, David A.
Christy, F. X.
Cipro, Thomas
Clark, C. C.
Conway, J. D.
Cotter, G. L.
Coulter, A. F.
Courtney, H.
Crawford, D. F.
Cunningham, R. I.
Dalzell, W. E.
Dambach, C. O.
Davis, Charles S.
Dempsey, P. W.
Devans, E. J.
Durkin, James E.
Edwards, C. H.
Emery, E.
Emsheimer, Louis
En Dean, J. F.
Endsley, Prof. Louis E.
Evans, David F.
Farrington, R. J.
Ferrick, J. T.
Fieldson, P. H.
Fitzpatrick, T. R.
FitzSimmons, E. S.
Fleck, John S.
Flinn, R. H.
Follett, W. F.
Forsberg, R. P.
Foster, F. L.
Frauenheim, A. M.
Freeman, P. J.
Freshwater, F. H.
Furch, George J.
Gardner, George R.
Gates, C. F.
Gatfield, P. J.
Geisler, Joseph J.
Germak, George A., Jr.
Glaser, J. P.
Glenn, J. H.
Goff, J. P.
Gorman, Charles
Haller, Nelson M.
Hancock, Milton L.
Hansen, William C.
Harper, G. C.
Henderson, George L.
Hervey, R. S.
Hilstrom, A. V.

Holmes, E. H.
Hoover, J. W.
Hughes, John E.
Huston, F. L.
Johnson, A. B.
Johnson, George T.
Johnston, H.
Kamerer, R. W.
Kelly, J. P.
Kennedy, F. J.
Kirk, W. B.
Kramer, William F.
Kruse, J. F. W.
Kummer, Joseph H.
Lanahan, Frank J.
Lanahan, J. S.
Lang, W. C.
Laurent, Joseph A.
Lee, L. A.
Lewis, Herbert
Long, R. M.
Longdon, C. V.
Lowry, William F., Jr.
Lunden, C. J.
Lynn, Samuel
Maliphant, C. W.
Mason, S. O.
Matchneer, W. W.
Mayer, L. I.
Meinert, Henry
Miller, J.
Misner, George W.
Mitchell, F. K.
Mitchell, W. S.
Moody, M. R.
Morgan, A. L.
Morgan, Homer C.
Mourer, Charles W.
Muir, R. Y.
Myers, Arnold
McAbee, W. S.
McElravy, J. W.
McIntyre, R. C.
McKinley, A. J.
McKinley, John T.
McMillan, A. P.
McNamee, W.
Nagel, James
Nannah, F. J.
Nash, R. L.
Nessle, J. B.
O'Connor, M. J.
O'Leary, J. J.
Orchard, Charles
O'Toole, Thomas J.
Painter, Joseph
Paisley, F. R.
Palmer, E. A.
Peterson, W. M.
Pickard, S. B.
Rauschart, E. A.
Raymer, I. S.
Read, A. A.
Redding, P. E.
Redding, R. D.
Reeve, George
Reynolds, D. E.
Richardson, H. R.
Robinson, R. L.
Roth, Philip J.
Saltic, Thomas
Sample, W. E.
Sattley, E. C.
Sauer, G. L.
Schmitt, Raymond F.
Schrecongost, C. P.
Schultz, D. C.
Schultz, Charles H.
Seibert, William L.
Seiss, W. C.
Severn, A. B.
Shannon, David E.
Sharp, H. W.
Sheets, H. E.
Shellenbarger, H. M.
Sheridan, T. F.
Smith, E. E.
Smith, F. C.
Smith, M. A.
Smith, R. W.
Snyder, F. I.
Stark, F. H.
Stearns, William G.
Stevens, L. V.
Stewart, L. R.
Sullivan, P. W.
Sutherland, Lloyd
Sykes, A. H.
Sylvester, H. G.
Temple, H. H.
Thomas, H. N.
Thomas, Theodore

Tipton, G. M.
Toussaint, R.
Trautman, H. J.
Van Blarcom, W. C.
Van Wormer, George M.
Weaver, W. Frank
Wheatley, William
Wheeler, C. M.
Wiggins, W. D.
Wikander, O. R.
Wright, Edward W.
Wright, John B.
Wurts, T. C.
Yarnall, Jesse
Yohe, C. M.
Young, F. C.
Zitzman, N. E.

VISITORS

Angstadt, Edward D.
Aukeman, J. W.
Barth, W. H.
Beckett, M. A.
Benson, Andy T.
Berbach, Leo J.
Boden, A. S.
Booker, George
Bott, W. J.
Bristow, John
Brooks, Charles
Carruthers, G. R.
Casey, John F.
Church, Samuel Harden
Clarkson, G. E.
Cotton, C. S.
Duggan, Frank L.
Dunham, C. W.
Dunn, C. A.
Dunn, Thomas A.
Eason, G. S.
Edwards, Charles
Egan, Judge John P.
Egan, Thomas
Ellison, J. V.
Farrington, A. R.
Friend, E. F.
Geisler, Joseph A.
Germerodt, H. E.
Geyer, H. L.
Gormley, M. J.
Graff, E. A.
Graham, J. W.
Groh, F. W.
Haas, J. W.
Hahn, H. A.
Hanna, R. B.
Harper, Kenneth
Harris, Hon. Frank J.
Herley, J. E.
Herron, John S.
Hewes, J.
Hillman, J. F.
Hubbard, J. J.
Hughes, I. Lamont
Hughes, W. W.
James, J. H.
John, William
Johns, Jay W.
Johnson, Henry D., Jr.
Johnston, R. M.
Josten, Louis J.
Kelly, John E.
Kentlein, John
Kepner, Ben L.
Kern, Roy S.
King, W. R.
King, Walter G.
Klassen, F. G.
Kraus, Raymond G.
Krick, F. H.
Kutley, George
Lang, Edward G.
Laughlin, John E.
Lewis, S. B.
Lowe, W. G.
Michaels, J. H.
Mitchel, Miss Grace
Mullooly, C. J.
McConn, G. E.
McKee, D. L.
McMullen, Harry
Nagel, James, Jr.
Oliver, W. E.
Overend, Clarence
Penz, O. F.
Peterson, H.
Phillips, John H.

Ralston, Guy L.
Reagan, R. C.
Reeve, G. J.
Reithel, B. H.
Schrontz, S. B.
Severn, Harry
Smith, Sion B.
Snyder, J. J.
Stevens, D. F.
Stroup, Earl N.
Vandivort, R. E.
Walker, R. H.
Walsh, Thomas A.
Wheatley, Albert R.
Wolf, Joseph
Wood, D.
Woork, J.

Musical entertainment was presented by Mr. R. C. Reagan, Tenor Soloist, and Miss Grace C. Mitchel at the piano, which was well received.

PRESIDENT: We will dispense with the call of the roll as the registration cards furnish a complete record of attendance.

If there is no objection we will dispense with the reading of the minutes as the proceedings are already in your hands.

We will now have the list of applications for membership:

SECRETARY: We have the following applications for membership:

Fretz, R. I., District Sales Representative, Reading Iron Company, First National Bank Building, Pittsburgh, Pa. Recommended by William C. Hansen.

Germak, George A., Car Inspector, P. & L. E. R. R., 529 Indiana Avenue, Glassport, Pa. Recommended by W. C. Lang.

Grove, C. G., Division Engineer, Pennsylvania Railroad, Pennsylvania Station, Pittsburgh, Pa. Recommended by C. M. Wheeler.

Hare, J. K. B., Central Transportation Manager, Westinghouse Electric & Manufacturing Company, Grant Building, Pittsburgh, Pa. Recommended by G. W. Honsberger.

Johnson, Harvey F., Rate Clerk, P. & L. E. R. R., McKees Rocks, Pa. Recommended by J. E. Hughes.

Keller, R. E., Lead Car Inspector, P. & L. E. R. R., 560 Stokes Avenue, Braddock, Pa. Recommended by W. C. Lang.

Layng, Frank R., Chief Engineer, B. & L. E. R. R., Greenville, Pa. Recommended by F. I. Snyder.

McMillen, Harry, Car Inspector, P. & L. E. R. R., 517 Fourth Street, Braddock, Pa. Recommended by W. C. Lang.

Pumphrey, C. H., Freight Traffic Manager, B. & O. R. R., Oliver Building, Pittsburgh, Pa. Recommended by J. B. Nessle.

Shield, Arthur, Assistant Auditor Freight Accounts, P. & L. E. R. R., 623 Sixth Avenue, New Brighton, Pa. Recommended by R. H. Anthony.

Snyder, J. J., Coal Freight Agent, P. & L. E. R. R., Pittsburgh, Pa. Recommended by H. R. Richardson.

Stearns, Leo C., Car Inspector, P. & L. E. R. R., 410 Monongahela Avenue, Glassport, Pa. Recommended by W. C. Lang.

Stearns, W. G., Car Inspector, P. & L. E. R. R., 1112 Soles Street, McKeesport, Pa. Recommended by W. C. Lang.

PRESIDENT: Applications will be referred to the Executive Committee, in accordance with the provisions of our By-laws, and upon approval the gentlemen will become members without further action than the payment of the current year's dues.

Is there any further business to come before the meeting at this time? If not, we are now up to the address of the evening—Subject—"Pittsburgh and the Railroads"—This subject should be of great interest to every one present, and it is a privilege as well as an honor for me to present to you Mr. Curtis M. Yohe, Vice-President of the Pittsburgh and Lake Erie Railroad.

PITTSBURGH AND THE RAILROADS

By CURTIS M. YOHE,
Vice-President, The Pittsburgh & Lake Erie Railroad Company

I am very grateful to you all for your kind reception and may I be pardoned in saying I am very proud in being asked to speak to you. No one familiar with the membership of this Club or knowing the purpose for its creation or your fine spirit of co-operation, evidenced by your accomplishments, could help but feel the honor bestowed.

While it has never been my good fortune to have attended any of your meetings I have always read the report of your proceedings and have had impressed on my mind two very important phases of them; first, the net balance which your treasury shows at the end of the fiscal year, and, second, the

number of men that come here totally unprepared to speak but when called upon deliver an oration that would do credit to Patrick Henry.

I notice that a great many member firms of our Club are represented by their salesmen, for whose calling I have the greatest respect. I know that the problems which confront you are very often quite complex in their character. As Purchasing Agent of my company for many years I had a close personal contact with many of you and you were always a source of education and inspiration to me, and while we went through some trying days together I never knew or heard of a salesman trying to take an unfair advantage of his competitor or of my company. The high ideals and business ethics which you maintained made my daily business life one of extreme pleasure. The railroad industry indeed owes much to you. Incidentally, in 1930 the railroads of the country spent a billion dollars for fuel and material and supplies, this figure being exclusive of material and supplies purchased indirectly for the railroads by contractors who carry on construction work, equipment builders, etc.

In looking at the general railroad situation today it hardly seems possible that I could add anything to what you men so closely associated with transportation matters have already read or thought about. I do wonder sometimes though if the shipping public during the past few years when the railroads have been giving service unexcelled in their history, have allowed themselves to unconsciously create a state of mind of just taking the railroads for granted. That perhaps is a very natural consequence when everything is going along fine. But, gentlemen, if this is a fact surely the time has arrived when the great shipping and consuming public should pause and give their earnest thought and study to our railroads. Their success so basically affects the best interest of our people and mean so much to the maintenance of our industrial structure to say nothing of their importance in the development of our natural resources. It is a business which we cannot look at through selfish eyes. Certainly there is no question but that the railroads have kept faith with the American public when you consider that they have spent over seven billions of dollars in the last ten years in modernizing their plant and have reduced the cost of transportation since 1921 by over six billion dollars through the reduction of freight rates. Take my own company for instance, we have during this period increased our invest-

ments in road and equipment by an amount in excess of one-half of our capitalization and I know you will find similar heavy expenditures by the other railroads in this district.

Permit me to emphasize that our money was spent for transportation purposes to enlarge yards, to increase the capacity of our main line, to keep pace with the development in modern signaling systems, to install automatic train control, to provide greater capacity freight cars, more efficient locomotives and to fully equip our trains with modern steel passenger cars; in fact, to do everything we could to give our traveling public ease and comfort and to handle the products of our shippers with such speed of movement as to better enable them to compete for business in all corners of the world.

The trunk line railroads in the Pittsburgh district today put our manufacturing plants almost in the backyard of many large consuming centers. For example, they make second morning delivery to Philadelphia, New York, Chicago, Baltimore and Detroit, with third morning delivery to St. Louis and Boston. Fast freight service furnished by all American railroads has revolutionized the buying policy of our country and has released large amounts of capital formerly tied up in inventories.

Knowing the history of and the reasons for the development of your great railroad systems, what they have meant to the development of this section of the country, the millions spent to provide facilities primarily to give public service and realizing that these facilities are almost unlimited in their capacity to take care of the business of the country for years to come, do you not think it natural that railroad men are gravely concerned today over the affect on their properties if some of the contemplated developments are made to inland waterway systems? As President Hoover said in his message to the 72nd Congress, these improvements are now proceeding upon an unprecedented scale. Some indication of the volume of work now in progress is conveyed by the fact that during the current year over 380,000,000 cubic yards of material have been moved—an amount equal to the entire removal in the construction of the Panama Canal. Are we to be criticized when we stop to give serious thought to our future life and our ability to serve our patrons with the same degree of efficiency which they have expected of us and which it has been our duty to give them in the past, especially when we know that the development, for instance, of a contemplated waterway to the lake

will mean the practical rebuilding of the railroads which it parallels?

I am not going to discuss the economics of this project but want to cite a few of the facts—facts mind you incidental to this proposition as affecting just the physical conditions of the companies which I represent. It means the raising of an equivalent to 52 miles of single track an average of five feet. This means increasing our grades with resultant increase in operating cost and an increased cost of maintenance incidental to a new roadbed. Five major bridges will be required varying in span from 280 feet to 580 feet; nine new major bridge spans will be required in present bridges, varying in span from 65 feet to 600 feet; one major bridge to be raised; nine minor bridges to be rebuilt; one minor bridge to be extended; fifteen culverts to be rebuilt; thirty-five culverts to be extended; eight highway grade crossings to be raised; numerous sidings and connections with industries will have to be adjusted to conform to the new grade; and our passenger station subways will have to be replaced with overhead foot bridges. This means an expenditure by us of many millions of dollars. You appreciate, of course, that the Government money to be spent on this project is raised by taxation, to which the railroads are heavy contributors.

Someone has coined a saying in effect that the spirit of trade lies in competition and we have until recently believed this to be true, but according to some of our most brilliant economists it is now found also to be in many respects a wasteful extravagance. During the current depression railroad managements have had this fact brought forcibly to their attention in the study of their many problems as how best to effect economies in the operation of their properties. Then too the public through our press has not been at all backward in bringing to our attention, and perhaps rightly so, the need on part of railroads generally to eliminate this factor of competition. But what of the other agencies of competition being constantly set up against us with which we are forced to compete? The competition between railroads, with its admitted faults in some respects, is nevertheless fair for we are all on practically the same basis and function under the same regulations. But, gentlemen, there is a grave question as to whether our being forced to compete with a subsidized agency IS fair. We have no fairy godmother building and maintaining our rights of way and exempting us from major taxation. Our backs are against the wall and for many reasons we cannot even fight.

I often wonder just what some of our famous pioneer railroad builders—Hill, Vanderbilt, Harriman—would do were they confronted with our present day problems. One thing is certain, they would stand amazed could they return and view the plight of our railroads today. We, as they, have in complete faith built for the future and built well. In comparatively recent years we have built in harmony with the spirit and intent of the Transportation Act of 1920. It is far from encouraging to find upon doing so that the anticipated traffic for which we built is being diverted from our rails. The Railroads, as already stated, have improved their facilities to an extent never before realized in the history of transportation and far beyond the dreams of their builders of another era. I do not think it at all boastful when I say that the railroads can today stand before the most severe critics of the past and prove their case.

We have no quarrel with other agencies of competition such as the truck, bus and waterways but we do feel that at least these means of transportation should be developed only as sound economic study proves they are necessary and that when once adopted we be placed on an equal footing with them as to competition or, better still, they be co-ordinated with us in the general scheme of transportation under the same powers of regulation.

Our personnel has been taught that we have but one thing to sell and that is "Service" and if I could take you with me into one of our yards at night where you could witness the enthusiasm shown by our men who work day in and day out and sometimes in rain, snow, sleet and fog, in order to keep your trains movings on time and thus give service which you have come to expect as an absolute necessity, I am sure that you would have a more comprehensive picture of that part of railroading whose value cannot be measured in dollars and cents.

To you railroad men here tonight: Be proud of your calling and relish the opportunity which you have to perform important work. Keep ever in mind that our business is to give service and that we have on our shoulders a great public trust. Let us invite constructive criticism but let us by earnest, sincere and conscientious effort merit whole-hearted public support.

Gentlemen, it is true that the railroads have been passing through some trying times but I for one am not pessimistic about their future providing the American public will only keep an open mind regarding the problems with which they are con-

fronted and realize the railroads—a twenty-six billion dollar industry—are the backbone of these United States.

PRESIDENT: We are honored tonight with the attendance of Mr. M. J. Gormley, Executive Vice President, American Railway Association, Chicago, Ill. Would like to hear from Mr. Gormley on the address made by the speaker of the evening.

MR. M. J. GORMLEY: I am called upon for the second time today to follow Mr. Yohe. I talked this morning before the Advisory Board meeting after he had finished his very excellent statement. I thought then that he had presented one of the most intelligent analyses of the railroad situation that I had heard for some time. I believe he has improved upon it this evening. In fact, he has covered the subject so thoroughly that it is difficult for me to say anything with reference to the general railroad situation without duplicating what he has already said. I could, of course, talk about consolidation; I could talk about the loaning plan in connection with the freight rate increases allowed in Ex Parte 103; or possibly I could talk about Chambers of Commerce. This latter gives me an idea, and I think I will take advantage of this opportunity to make a few remarks on my observation of the conduct of some Chambers of Commerce.

I sometimes wonder whether the membership making up these organizations really takes its job seriously or whether they do not delegate the major part of their work to some hired man. Unquestionably, Chambers of Commerce are very constructive in the conduct of the affairs of a community, but at the same time they do some things that are very amusing to me. I have in mind now the Chicago Association of Commerce. I understand that very recently they passed some ringing resolutions and participated in the setting up of some organization—I do not now remember its name—to keep the government out of business. That is fine, but the amusing part is that when they passed this resolution they apparently overlooked entirely a previous resolution that they passed in which they asked Congress to appropriate 15 million dollars to keep the Mississippi-Warrior Barge Line, a government owned and operated transportation agency, in existence. In other words, a railroad man gets the impression that they want the government to stay out of business unless it is some business that competes with the railroads. To say the least, it indicated a great deal of inconsistency in their position, which prompted my first query as

to whether the members of these organizations really took some of these things seriously. Along with this, I believe this same organization stamped its approval to a proposition that the United States Government float a 500 million dollar bond issue for the purpose of further expansion of waterway transportation.

A great deal has been said about the relationship of the prosperity of the country to the prosperity of its railroads, but I wonder how much honest study has been given this very important question by the average Chamber of Commerce and the average business man. I think it has been proved beyond any question of a doubt that we cannot have a prosperous country without prosperous railroads, for the simple reason that any dimunition of the buying power of the railroads due to a reduction in railroad revenues has a direct bearing on the general business condition of the country.

There is no doubt in my mind that the salvation of the railroads in the future lies in a continual reduction in their transportation costs in every possible direction. They have made wonderful progress in the reduction of their costs of operation since the adoption in 1923 of the now-famous Program of Rehabilitation. Had it not been for the money they spent for improvements which lessened costs of operation, the railroads would not, even in the heavy traffic year of 1929, have had very much net income. They cannot continue this program of additional improvements, with resulting reduced costs of operation, unless they have the proper credit with which to finance such purchases, and they cannot have that credit unless there is a better understanding on the part of the general public and regulating authorities as to that prime necessity.

In times like these, we frequently hear that the railroads need this, or that or the other things. Sometimes I think that what they need most is protection from their well-meaning friends who are continually placing before the public panaceas of supposedly great worth and which indicate in a great many instances a lack of knowledge of the real problem. Something has been said about the necessity for some sort of large research bureau on the part of the railroads. People who make that statement have no knowledge of the very large research organization the railroads now have through the medium of the co-ordination of the best thought on all railroads in the various committees of the American Railway Association. Ably assisting in this work are the railway supply manufacturers. It is very questionable if the attempt to concentrate all of this research

work under one head would ever have accomplished the results that have been produced in the last several years. We now have the advantage of the inventive genius of everyone in the railroad industry, as well as in the railway supply industry, and we believe the records will show that no industry has made an improvement in the efficiency of their operation that exceeds that of the railroads.

PRESIDENT: Thank you, Mr. Gormley. Gentlemen, we are honored tonight by having with us the President of the Carnegie Institute and the creator of the Liberal Party, Mr. Samuel Harden Church. We shall be pleased to hear from him.

MR. SAMUEL HARDEN CHURCH: Mr. President and Gentlemen: When my good friend Frank Lanahan invited me to come down here and have dinner with him and listen to this interesting discussion he did not say anything to me at all about having to make a little speech myself. I had absolutely no notice of anything of that sort until your President at this last moment has mentioned my name.

It is an old story, coming to dinner with Frank, that you get from the nursery tales:

"Little Tommy Tucker
Sings for his supper."

I listened with a great deal of interest to Mr. Yohe's fine address. It brought my mind back to the railroad problems which I used to study in a much more definite way than I do today. But no man here can look upon the railroad situation as it is unfolding itself today in the United States without deep sympathy and profound anxiety. We used to say that the railroad is the pulse of trade. And I believe that is true. When the railroads are operating to their capacity, the shops and stores and business and commerce of every kind are operating to their capacity. And when you look upon the side tracks and in the railroad yards and see that forty per cent of the equipment of these great arteries of commerce are stored upon the side tracks and going to rust and decay without any call whatever for their utilization, we are brought face to face with a situation which is tragic in the exterme.

I have been wondering, as every man in this room undoubtedly has done, about what is the cause of this paralysis that produces that situation in the railroad yards and in these other institutions which feed the railroads. And I do not know but

that I may have found the solution. I was in New York a week ago and spent several days there. In the downtown district I found myself with several minutes of leisure and I went over into the Empire Building, and went up in the elevator to the eightieth floor and got out there and called upon Mr. John J. Raskob and listened to some of his great and strong ideas for the restoration of liberty in this country, although I am not a Democrat nor a Republican—I am a Liberal. (Applause). I was going to say until I heard that applause that the entire Liberal party of the United States was upon this platform. (Laughter). Now I believe there are a whole lot of Liberal men—and one Liberal woman, I hope—in this audience. (Applause).

But going from the 80th floor to the 102nd floor, I looked around upon the scene that was unfolding itself under a beautiful blue sky, and I thought of another man two thousand years ago, who went up into a great height and viewed all the kingdoms of this world. And in my imagination I began to view the kingdoms of this world, and I found that they are all in the same distress, and perhaps despair, which is taking hold of the people of our own country. And then I thought of a story that Jesus told about a farmer who had great crops. He was a rich man and had large barns, but he had such great crops that his barns would not take care of it all, and he said, "I will tear these barns down and build bigger ones and I will have then all the wealth of this land in my possession, and I will sit down and say unto my soul, 'Soul, take thine ease. Eat, drink and be merry, for thou hast much goods laid up for many years.' And then Jesus goes on to tell us that God had something to say about that situation, and God spoke and said, 'Thou fool! This night shall thy soul be required of thee. And then whose are all these things of which thou hast boasted?' "

And then from that high place when I looked down upon the earlier skyscrapers, the great hotels, the Chrysler Building, always on an ascending scale of extravagance and magnificence, until it all culminated in this wonderful Empire Building—and the superintendent told me, "We have actually come to the pass in New York where we are tearing down the skyscrapers of five years ago in order to put up bigger ones"—When I saw and heard all this, I thought, there is the solution of the problem before the American people.

I wonder if that is not true. There was a great man in this country a hundred and fifty years ago, Benjamin Franklin,

and in his autobiography he told the story of the whistle. There was another boy that had a whistle and Benjamin Franklin gave him his lunch for that whistle. In a very happy frame of mind he started down the road blowing the whistle, while the other boy ate the lunch. He had a very good time until he got hungry, and then he realized that he had paid too much for his whistle. I think that is what America is doing today.

When Jesus told that story,—and when I got home I looked it up and found it in the 12th Chapter of Luke in a book which I used to read and still read pretty consistently—he followed it up with this wonderful announcement to comfort the people who were in the same situation that we are in today, and I wonder how far we have got away from it: "A man's life," He said, "consisteth not in the abundance of the things which he possesseth." And I thought that perhaps America had lost her soul in over-building these big barns and had not yet come to a realization that her life "consisteth not in the abundance of the things which she possesseth."

Benjamin Franklin taught thrift. His name stands for thrift. They have his statue in the Mellon Bank, because that is the thought that goes with the face of Franklin, "Save your money," do not pay too much for your whistle. When we were doing that in America, when our people were buying homes and paying for them, and saving from their salaries and keeping part of their possessions in a savings bank for a rainy day—Eddie Cantor says, "Saving up for a rainy day! And we don't know that it is raining like hell right now." (Laughter).

We have got away from that. There has come a new principle, and I say it with some hesitation in the presence of so many salesmen who are doing so much to restore prosperity, a new principle of salesmanship in this country in recent years. It is not "Save your money," it is not "Do not pay too much for your whistle," it is "Spend all you have got." When these automobile manufacturers started out the first thing they required was cash. If you didn't have enough cash you had to go and get your own note discounted at the bank and pay for your car in that way. But when they had saturated the cash customers, they brought out these credit organizations; and they said, "Pay $10.00 on the car and drive it out of the garage and it is yours!" But it never was yours. So with the radio and the ice box and everything else—instalment paying. And even at Washington today, in all that confusion of ideas, the only note you can hear, the only clear spoken note, is this false

theory that men must have wages, not so they can save and buy homes and protect their wives and children in the day of trouble, but in order that they may spend every dollar that comes to them. And that is what has broken down the whole economic system of the world. Germany borrows billions of dollars from us, using our money to finance every luxury they can think of or dream of, and using the rest of our money to pay her war debts to our Allies, and that same money the Allies pay back to us. When we will not lend any more money the whole absurd and vicious thing is stopped, and this iniquitous credit system is thrown to the ground.

And this brings me back to Mr. Yohe's speech, and it is a long way around. We never can get those conditions Mr. Yohe wants and get that 40 per cent of equipment of the American railroads back on the rails and in service until we liquidate this situation and get back to the original American principle of thrift and saving, coupled with energy and productiveness. Then and then only shall we recover from this disaster and this industrial paralysis.

PRESIDENT: Thank you, Mr. Church. We have another gentleman with us, who has sacrificed his time to come to this meeting, a very busy man whom we are certainly very glad to welcome. We would like to have a few remarks from Mr. I. Lamont Hughes, President of the Carnegie Steel Company.

MR. I. LAMONT HUGHES: Mr. President and Members of the Railway Club:

I came here upon the invitation of Mr. Lanahan, but I did not know that I was to be called up here. However, I feel quite at home, as I have found a brother Hughes of the P. & L. E. Railroad, and another brother Hewes with the B. & O., so I feel that we are all brothers here together.

I feel at a disadvantage in getting up to speak at a railroad meeting after hearing Mr. Yohe's address, and even more so when I heard the speech delivered by Mr. Church, who is both a railroader and (judging from his quotations from the Bible), I would say, a minister. For a steel man to be called upon for remarks under these conditions, knowing neither the railroad nor the Bible, is indeed getting up against a hard proposition.

Without attempting to equal Mr. Church's proficiency, I might say that I, too, have read the Bible in my early youth, and I, also, can look back to where I read about the feast of Belshazzar and about the handwriting on the wall. Daniel was

called in before the King and was asked to interpret this strange writing. And Daniel read the writing, which, as I remember, was "Mene, Mene, Tekel Upharsin," which meant—"Thou hast been weighed in the balance and found wanting." I think that is the reason for the troublesome times through which we are passing,—that we all have been flying too high and shooting far above the mark at which we should have aimed; and when we get down on a permanent basis and start over again, only then will things come back to where they belong.

As I have said, I do not know much about railroading; but I do know that normally the railroads are good customers, and while I was pleased to hear of the millions of dollars that Mr. Yohe quoted as having been spent in the past year for maintenance and materials, yet I could not but hope that they may be able to scrape up a few such millions for expenditure next year and get things started again.

In my connection with manufacturing activities, I have come in contact with many railroaders and have found them to be good, first class, upright men,—men who do their work under any conditions, in any kind of weather, as Mr. Yohe has said,—who go out of their way and work over-time and do anything to keep our mills going and keep the supplies coming in order that we may continue to convert the raw materials into finished steel as the product is required. Mr. Yohe mentioned the great efficiency of the railroads and referred to reduction of inventories. That is all well and good, to put the customer in our back yard. But in the old days when they did not have anything like this quick service, we had time enough to get the orders in a regular way, arrange for most advantageous production in the mills, paying particular attention to producing the steel in accordance with specifications, and shipping it far enough in advance that they would take some of the material into their own warehouses and not rush us to death. We had an illustration last week of present-day delivery demands, when we received an order from Detroit at 3 o'clock, P. M., saying that "if you cannot ship this at once, you cannot have the order." Our mills are only running intermittently. We investigated to determine in what mill the material could most readily be produced, learned that the rolling crew had gone home, and had to send word to their homes to get the crew back again. At 11 o'clock that night we rolled the order, and at 8 o'clock the next morning the railroad was taking the material to Detroit. Neither ourselves nor the railroads make any money on such shipments. It is

being too efficient. Specifications today are very rigid, because it has been a buyers' market. We do not ship any steel in which there is a flaw or a little sliver. We endeavor to make it just right. They even specify the carbon content within a five-point range, and there is a question as to whether any two chemists can check that closely.

Now, today, that we have to make stock steel in advance of requirements, in order to meet special delivery demands, we carry many thousands of tons of slabs and billets of different sizes, and for many different specifications, and instead of the customer carrying in his inventory what he should, we carry it for him.

I might mention just one little incident that came to my attention years ago which illustrated the importance of the railroader's job. When I was General Superintendent of the Youngstown District Works of Carnegie Steel Company, we had a big, strong, husky, Irish locomotive engineer, who prided himself in his ability to "knock out" anybody who crossed his path. If the conductor gave him too many orders, he argued it out with the conductor. If the brakeman gave him the wrong signal, as he thought, he got out and knocked him over. It came to the point where we had either to get rid of this engineer, or we would not have any crew left in the yard. So we warned him, but he did not heed the warning. One day he got out of hand and I fired him. Unfortunately he had a nice wife and six children. After he had been off for six weeks and had tried unsuccessfully to get back two or three times, his wife came to see me, cried, and said they hadn't anything in the house and the children needed food. I said,—"I warned your husband that he must stop his fighting ways, but he did not heed the warning, and there was nothing else for us to do but part company." She looked at me a moment and said,—"Mr. Hughes, he has a lot of worries on his job. You haven't anything to worry you." So, in the face of that, what could I do? I took that man back, and he is still working for the Company. I thank you.

PRESIDENT: Thank you, Mr. Hughes. The people of Pittsburgh feel that they have in the President of Council, the best looking man in any position in the City Government, and we are honored with his presence here tonight, and I would like to ask Mr. John Herron, President of City Council of Pittsburgh, to say something to the Club.

Mr Chairman and Gentlemen:

After the flattering introduction of the Chairman, you men will now be able to judge for yourselves just how true this statement was.

I received the biggest kink I ever had in my life in hearing Mr. Yohe reading his splendid paper and explaining so clearly, as he did, the problems that confront the average railroad man in an Executive position and then when I heard Mr. Gormley describe his experiences with the Chambers of Commerce and knowing, as I did, that our President of the Chamber of Commerce here, Tommy Dunn, was present, it was a "feeling that only comes once in a lifetime."

All of us have certain problems that we must meet—all of us carry a certain amount of responsibility. As one of the men who fix the tax rate for the City of Pittsburgh that brings in the money necessary to run this government, I had occasion to look over the list, today, of our large taxpayers and I want to say to you, gentlemen, that the largest check—one that is more than one million five hundred thousand dollars—is written by the Treasurer of the Pennsylvania Railroad, and without that Mr. Gormley, we would be in a very bad way, so do not do anything that would prevent our receiving that check.

It is amusing sometimes, to get a resolution from various Boards of Trade and Chambers of Commerce, telling how important it is to build a highway or some other public improvement and to have us influenced by just such requests and then we pass the necessary ordinances that will bring the desired thing into a reality, and then when it comes time to levy the taxes, to be accused of having no regard for the taxpayer and have someone make a comparative statement showing the increase of taxes from one year to another. The Council must find the money to pay for all these things you are enjoying today, and unfortunately, a great many people do not understand that most of the large improvements are financed by bond issues which are carried for periods up to thirty years and that payments to liquidate these bond issues must be made in installments for the period of years for which the bonds are issued.

However, I am very glad to be with you. It is a wonderful thing to be able to get closer to men of affairs and to find that there is very little difference between my own and your problems. You haven't any idea of what your neighbor is thinking about, but all you have to do is to look at him a few

moments and you know he has worries too. So, Mr. Hughes, I sympathize with the wife of that gentleman. She certainly did have some worries,—six children and a husband without a job. We have all seen trouble. In this City, we have men who have never been out of work before—men who never knew what it was to be out of a job, and we are trying to help them by helping those who are able to help us by providing employment for these men; trying to make him independent by giving him a job. We who are in Council have been glad to do it.

But, on the other hand, we have a great many people who say that unless we reduce taxes, industries will be driven from the City; that it will make it impossible for men to own their own homes because there will be no incentive for so doing. If we could provide all the labor which is necessary to supply all the unemployed with jobs, taxes would be so high, they would confiscate the peoples property, yet we cannot turn a deaf ear to the suffering and have tried to handle the situation as best we knew how. So, we feel tonight that we all have something in common and I again thank you for the opportunity of being with you and enjoying your hospitality.

PRESIDENT: Thank you, Mr. Herron. We have another gentleman in the audience who can tell us about state laws that govern transportation and a lot of other things. We are especially honored by having with us Honorable Frank Harris, State Senator, and I am sure he will be glad to say a word to us.

HON. FRANK G. HARRIS: Mr. Chairman, Gentlemen, it is a very great honor to be here this evening. I enjoyed immensely the fine address of Mr. Yohe. It was very enlightening and very interesting. And I enjoyed the speech of Mr. Hughes, especially the story of the gentleman he had to discharge. He did have worries. But can you imagine anything more difficult than being a member of the State Senate and having all the people clamoring for relief for the destitute and the unemployed, and at the same time all the people opposing any increase in taxes. I believe we all have some worries.

Then there is another great idea. Every day we have to deal with the Philadelphia organization on the one side and Governor Pinchot on the other. And I say to you railroad men in this vicinity and Mr. Hughes of the Carnegie Steel Company, you have no worries! I realize that the business you are engaged in is a most difficult one. You have competition on the

ground, on the roads and rivers, in the cars, and now overhead in the air. I think the men who are charged with the making and the administering of the laws should give great study and great consideration to the work of the railroads. I do not know of any business that faces more difficulties than your business does today. And I will say just briefly in my capacity as a private citizen or a member of the Senate of the Commonwealth of Pennsylvania, if I can render you any service I am at your command. I thank you.

PRESIDENT: Thank you, Senator. We have in the audience a modest gentleman, who has been absorbing the information presented by the various speakers, he being one of the successful candidates in the recent election, a scholar and educator, well known by most of you. I take great pleasure in presenting Hon. Judge Egan of Allegheny Court.

The Hon. John P. Egan, Judge, Common Pleas Court of Allegheny County, entertained the members in a very interesting and humorous way.

PRESIDENT: Thank you, Judge. We have heard from Railroads, Education, Industry, City and State Government and the Judiciary. We have another gentleman to whom all these important matters are just a part of his daily work and comes in personal contact with all of them, and recognized as one of the civic leaders of Pittsburgh, Mr. Thomas Dunn, President, Chamber of Commerce of your city, Mr. Dunn.

MR. THOMAS DUNN: I was invited at one time to go to Franklin, Pa., to make a talk and I was looking for an inspiration. Speakers look for inspiration. I was perplexed where I would start about Pittsburgh. About that time the chorus started to sing "My Old Kentucky Home". My mind immediately reverted to Stephen Collins Foster, a man that especially belongs to Pittsburgh.

Gentlemen, it looks like I am on the defensive. I am going to give him something to take back to Chicago and tell the Chamber of Commerce of that city the reverse order of affairs. I have in the audience at least two of the Directors and I have to watch my step. Last June when the railroads applied to the Interstate Commerce Commission for an increase in railroad rates of 15 per cent I had the experience of being Chairman of the Committee on Railroads and Transportation of the Chamber of Commerce for nine years. When the President of that day,

Mr. A. L. Humphrey, appointed me, some one said, "What does that fellow know about railroads?" He said, "That is the reason we are making him Chairman of Railroads and Transportation." But I had the laugh on them. I had brought into Pittsburgh for twenty-five years 3,000 cars of ice a year. And my good friend Sir Henry Thornton was then Superintendent of the Erie and Pittsburgh Division at New Castle. I used to get him on the telephone every Sunday and he always tried to dodge me as much as he could. I met him at the Duquesne Club a couple of years ago and he did not know me. He said, "Where have I seen you?" I said, "You did not see me but I used to telephone to you every day or so." He said, "Yes, I get you now, and I tried the best I could to keep away from you." I used to tell him that unless he hurried up that shipment of ice we would not get anything but the numbers on the cars.

Coming back to the subject, after nine years experience as Chairman of Railroads and Transportation of the Chamber of Commerce, and they have a splendid traffic organization there, and after having served fifteen years as a Director in the regular order of affairs I was made President of the Chamber of Commerce.

However, when the Interstate Commerce Commission was appealed to by the railroads I thought I knew my job. Before taking any action I called on three of the outstanding financiers of Pittsburgh. I said, "I have a vision that here is a duty for the Chamber of Commerce of Pittsburgh to appeal to the Interstate Commerce Commission for a raise in these rates. I think it is due the railroads." Well, we called a meeting of the Board of Directors on July 1 and there were thirty men there, and I say frankly they represented tonnage. And my friend, Mr. Gormley, who is a railroad man may take this back to Chicago that the great Pittsburgh District in 1928 created 211,000,000 tons of tonnage and that is more than Chicago, New York and Boston all put together. I sat in that room with thirty outstanding men of this city and I saw thirty votes cast in favor of giving the railroads that 15 per cent.

And we went farther. We sent a missionary down there who knew his job and he appeared before the Interstate Commerce Commission and told his story and presented the resolution of the Chamber of Commerce of Pittsburgh. What else did we do? Within two months afterwards there was a proposition made for a $500,000,000 bond issue to log roll river improve-

ments. What did the Chamber of Commerce of Pittsburgh do? They voted twenty-eight of the Directors against it. And they did not stop there. They delegated me to go to St. Louis and make a fight against that $500,000,000 bond issue. I spent two days there and saw the Pittsburgh delegation vote unanimously against it. After which I took that resolution and went down to Washington and I was honored with a fifteen-minute audience with the President of the United States for the purpose of recording a resolution against the $500,000,000 bond issue and he insisted we were right. I saw the Secretary of War, Mr. Hurley, and I gave him a copy. And Lieutenant-General Borden, in charge of all the Water Ways in the United States, was 100 per cent against it. Now we, of Pittsburgh, where we create tonnage, know the conditions, and there is not a man among the biggest shippers in Pittsburgh who is not strong for giving the railroads just what they asked for, the 15 per cent.

That is so much for the Chamber of Commerce of Pittsburgh. Now I have in the audience here Mr. Nessle, for many years a Director, and Senator Harris, a Director, and I think they will qualify, and my friend Mr. Gormley gave me the inspiration, that those are the real facts. The average citizen in Pittsburgh today thinks the railroads get everything for nothing. We have been told that the railroads pay $18,000,000 for taxes in Pennsylvania and that the biggest check that comes in to the city is from the Pennsylvania Railroad. I know the facts. But the average citizen has a vision that the railroads get everything for nothing and the time has about arrived, and I would like to put it in words, when there should be a little truer light on the subject. There are about 20,000,000 policy holders of life insurance in the United States. What has that to do with it? Everything. The life insurance companies of the United States hold a billion and a half of railroad securities and if those securities go down so does the reserves and the value of every one of those life insurance policies. That is the place of the railroads in the United States. I have always been a friend of the railroads. As yet I have not found them very wrong. They are wrong occasionally, but not in this. I appeared before the Interstate Commerce Commission three years and a half, I attended eleven hearings before that Commission and I would like to appear again and tell them if they want to do a good job, give the railroads this raise. Why did I appear? Because I felt that my city was being injured in the lake cargo case and I fought that case three years and a half.

Was that trying to injure the railroads? No. I was trying to hold 30,000,000 tons of coal for the Pittsburgh District. And that was a patriotic fight for my native city.

If I haven't said enough for my friend Mr. Gormley to take back to Chicago I am mistaken. I thank you.

PRESIDENT: Thank you, Mr. Dunn. Our time is getting late. We have had a splendid meeting, a very wonderful discussion of various subjects, but we have a member of this Club from whom we always expect to hear if he is present, and I take pleasure in calling upon Mr. Frank J. Lanahan, Chairman of the Executive Committee and a past president of this Club, for a word or two before we close.

MR. FRANK J. LANAHAN: Mr. Chairman and Fellow Members, as you have given me credit for being responsible for the attendance here tonight of the gentlemen who so far have addressed you, may I remind you that there is equally brilliant talent among those others who are my guests this evening, whom I trust will favor us later with their remarks.

The colloquy between my two good friends, Tom Dunn and Mike Gormley, is a fruitful reminder of the Kilkenny cats. As neither of them lay claim to German ancestry, you can readily understand the Hibernian humor associated with their arguments. Mr. Dunn might have added to his remarks the service that he rendered to the transportation lines at different times in the Pennsylvania Legislature. I have heard it said that no layman of our city has been more helpful in certain lines of legislation effecting the economic operation of the railroads than my life long friend, Tom Dunn. However, unlike the President of the Pittsburgh Chamber of Commerce, I do **not** ask Mr. Gormley to take that back to Chicago, but it would be most gracious of that gentleman with the happy disposition to remember this on any occasion in the future that he is determining the tangible value of our local Chamber of Commerce.

MR. GORMLEY: You will notice, Mr. Lanahan, that I did not mention Pittsburgh.

MR. FRANK J. LANAHAN: Thank you, Mr. Gormley.

If time but permitted, it would be a delight for me to comment at least partially on the splendid addresses which have been presented this evening, and especially would it be a pleasure to review the temperate, able and considerate paper of Mr. Curtis Yohe, but it would not be fair to consume the time

of the others who are to follow, so I will merely mention the little couplet that ran through my head as I listened to his splendid address:

> "Backward, turn backward, O Time in your flight,
> Make me a boy again, just for tonight."

If this miracle were to happen and we were all carried back twenty years, when the speaker of the evening was in swaddling clothes, all of us can picture the dignified gentleman who would then have been on the rostrum—none other than one whose name is beloved by every railroadman of his acquaintance, genial, obliging and happy "Sunny Jim", the illustrious father of the present Vice President of the Pittsburgh & Lake Erie Railroad. And now, in the whirligigs of time, we find his position of honor occupied by his son. That he is a worthy successor is well demonstrated since taking over the reins of responsibility in the handling of the "Little Giant". To you who have listened to the paper this evening, I am content to leave the rendering of the verdict as to his future.

With the other officers of the Railway Club do I rejoice in the large gathering that is here assembled. It warms the cockles of our hearts to see such a turnout. A pronounced pleasure do I derive from having some of my non-member friends in attendance, that they may meet you, my associates in the Club, and have them learn the type of organization that is ours; one that meets monthly to discuss matters to the railroads, mechanical and general operations, civic affairs where they pertain to transportation matters, and further have these guests of mine see with their own eyes that it is composed of all strata of the railroad field, and those who furnish them supplies. Frequently in the past have comments been made as to the democratic composition of the Railway Club; in our assembly, rubbing elbows with the officers are the men from the shops as well as the repair yards. Not only does it embrace the officials, but likewise the horny handed sons of toil. It is truly indicative of equal rights and opportunities—true Americanism. The measuring stick is the degree of service to the organization, and the reward of performance is advancement in the official family. If this policy were generally accepted in all other walks of life, as it is in our body, there would be no shadow of Bolshevism to make its unwelcome appearance in the path of this dearly beloved country of ours.

Indebted are we members of the Club to you gentlemen

who have followed Mr. Yohe. Your remarks have been truly enjoyable, and for not alone myself, but the membership in its entirety do I wish to express gratitude for your contribution in making the meeting tonight most interesting and express to you collectively and individually, a cordial invitation to come again and help us duplicate the success that this meeting tonight unmistakably has been.

PRESIDENT: Gentlemen, it is about time to close our meeting. There are many others here that I know you would like to hear, but on account of the lateness of the hour we will have to postpone that pleasure. There are two other gentlemen, however, I would like to introduce to the audience without asking them to make any response. If they will just kindly arise when I call their names, it will be a pleasure to me to introduce them to the members of the Railway Club of Pittsburgh. One of them is one of the staunchest citizens and builders of the City of Pittsburgh. Many of you know him by reputation, but many of you may not know him personally, Mr. John F. Casey.

(Mr. Casey acknowledges the introduction by rising in his place).

The other gentleman is Director of Public Works of the great city of Pittsburgh and I am sure it is a pleasure for me to introduce and for you to know Dr. Edward G. Lang.

(Dr. Edward G. Lang also arises in acknowledgement).

Mr. F. I. Snyder, may I call on you for a word in connection with the closing of the wonderful meeting which we have had?

MR. F. I. SNYDER: Mr. President and Gentlemen: We have had an excellent paper tonight by Mr. Yohe and there has been considerable discussion on a number of vital subjects of interest. The question of waterway development is a very popular one at this time. Hitherto the discussions have been largely from the point of view of the proponents of waterway development and I think for that reason Mr. Yohe's paper tonight has been particularly pertinent and valuable in showing something of the other side of the question not only in the way of competition but also the affect on the properties of the railroads and the property in the communities of the district generally. The topography in this part of the country is such that the construction of the railroads has to a very large extent followed the waterways. Changes in the character of the waterways as proposed will necessarily result in marked changes in

the properties of the railroads, and the paper of the evening has emphasized the extent and nature of some of those changes. I would like to move a rising vote of thanks to Mr. Yohe for the paper and to the gentlemen who have participated in the discussion.

The motion prevailed by unanimous vote.

ON MOTION, adjourned.

J. D. CONWAY, Secretary.

RESERVED

OFFICIAL PROCEEDINGS
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Chromium Plating Applications in the Railway Industry

By N. H. McKAY, Manager and Metallurgist,
United States Chromium Corporation, Pittsburgh, Pa.

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OF

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Organized October 18, 1901

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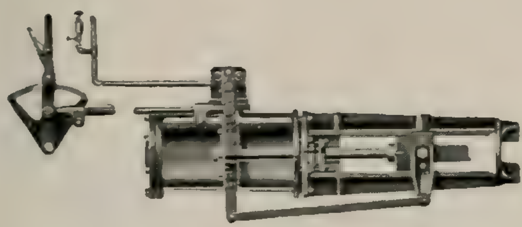

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*L. H. TURNER	November, 1903, to October, 1905
F. H. STARK	November, 1905, to October, 1907
*H. W. WATTS	November, 1907, to April, 1908
*D. J. REDDING	November, 1908, to October, 1910
*F. R. McFEATTERS	November, 1910, to October, 1912
†A. G. MITCHELL	November, 1912, to October, 1914
*F. M. McNULTY	November, 1914, to October, 1916
J. G. CODE	November, 1916, to October, 1917
*D. M. HOWE	November, 1917, to October, 1918
*J. A. SPIELMANN	November, 1918, to October, 1919
H. H. MAXFIELD	November, 1919, to October, 1920
FRANK J. LANAHAN	November, 1920, to October, 1921
SAMUEL LYNN	November, 1921, to October, 1922
D. F. CRAWFORD	November, 1922, to October, 1923
GEO. D. OGDEN	November, 1923, to October, 1924
A. STUCKI	November, 1924, to October, 1925
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G. W. WILDIN	November, 1926, to October, 1927
E. J. DEVANS	November, 1927, to October, 1928
W. S. McABEE	November, 1928, to October, 1929
E. W. SMITH	November, 1929, to October, 1930
LOUIS E. ENDSLEY	November, 1930, to October, 1931

*—Deceased.
†—Resigned.

Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING
JANUARY 28, 1932

The regular monthly meeting of the Railway Club of Pittsburgh was called to order in the English Room of the Fort Pitt Hotel at 8 o'clock P. M., with President J. E. Hughes in the chair.

The following gentlemen registered:

MEMBERS

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Davis, Charles S.
Downes, D. F.
Dunbar, Harold F.
Durkin, James E.
Edwards, C. H.
Emery, E.
Emsheimer, Louis
En Dean, J. F.
Endsley, Prof. Louis E.
Evans, Robert E.
Frauenheim, A. M.
Freshwater, F. H.
Fry, Lawford H.
Fults, J. H.
Furch, George J.
Geddes, James R.
Gellatly, William R.
Glaser, J. P.
Gorman, Charles
Grieve, R. E.
Hackett, C. M.
Hancock, Milton L.
Hansen, William C.
Hare, J. K. B.
Hayward, Carlton
Henderson, George
Holmes, E. H.
Honsberger, G. W.
Hoover, J. W.
Howard, L. F.
Huber, H. G.
Hughes, John E.
Irwin, R. D.
Jones, H. W.
Kelly, L. J.
Kerr, C. R.
Kirsch, O. W.
Kruse, J. F. W.
Kummer, Joseph H.
Lanahan, J. S.
Landis, William C.
Lang, W. C.
Laughner, C. L.
Laurent, Joseph A.
Leban, J. L.
Leet, C. S.
Lehr, Harry W.
Lowry, William F., Jr.
Lynn, Samuel
Maliphant, C. W.
Manning, J. F., Jr.
Meinert, Henry J.
Millar, C. W.
Miller, J. F.
Misner, George
Mitchell, W. S.
Morgan, Homer C.
Moses, G. L.

Myers, Arnold
Myers, B. E.
McIntyre, R. C.
McKay, N. H.
McKinley, A. J.
McKinley, J.
McKinstry, C. H.
McLaughlin, H. B.
McNamee, William
Nash, R. L.
O'Leary, J. J.
Orchard, Charles
O'Toole, J. L.
Paisley, F. R.
Pickard, S. B.
Pringle, H. C.
Provost, S. W.
Reeve, George
Sattley, E. C.
Schaffer, W. E.
Schmitt, Raymond F.
Schultz, Charles H.
Schultz, D. C.
Seiss, W. C.
Severn, A. B.
Shellenbarger, H. M.
Snyder, F. I.
Stamm, Bruce B.
Stevens, L. V.
Sutherland, Lloyd
Thomas, T.
Tovey, George F.
Tucker, J. L.
Van Blarcom, W. C.
Van Wormer, George M.
Waterman, E. H.
Weaver, W. Frank
West, G. S.
Wheatley, William
White, Charles G.
Wildin, George W.
Wright, Edward W.
Wright, John B.
Yarnall, Jesse

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Mitchell, Paul L.
Muck, G. M.
McClay, William
Pla, R. A.
Radtke, J. E.
Rippier, H. J., Jr.
Rowles, H. N.
Scott, H. R.
Scott, W. A.
Sekera, Charles J.
Severn, Harry A.
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Smith, T. S.
Stein, J. A.
Sutherland, F. D.
Trox, Louis R.
Trumbull, T. S.
Vandivort, R. E.
Van Wie, L. G.
Vollmer, Walter K.
Wheatley, Albert R.
Woolslare, M. H.
Wray, R. W.

A musical program was presented prior to the meeting by the Westinghouse Air Brake Company orchestra, through the courtesy of Mr. John B. Wright, Assistant to the Vice-president, which was very highly appreciated, and acknowledged by a rousing vote of thanks.

PRESIDENT: The roll call will be dispensed with because the registration cards give us that information.

The reading of the minutes will be dispensed with because they have already been published and are in your hands.

The Secretary will now read the list of proposals for membership:

Casey, John F., Chairman of the Board, John F. Casey Company, P. O. Box 1753, Pittsburgh, Pa. Recommended by J. D. Conway.

Cook, Sidney J., Vice-President, Egan Webster Company, Inc., 1402 Oliver Building, Pittsburgh, Pa. Recommended by John E. Hughes.

Davies, Benjamin S., General Secretary, P. & L. E. R. R. Y. M. C. A., Dickerson Run, Pa. Recommended by John W. Kempton.

Klein, Nicholas P., Foreman Car Repairs, Pennsylvania Railroad, 50 South Thirty-third Street, Pittsburgh, Pa. Recommended by H. G. Huber.

Kraus, Raymond E., Mechanical Draftsman, P. & L. E. R. R., 223 Fisk Street, Arsenal Station, Pittsburgh, Pa. Recommended by Thomas F. Sheridan.

Michaels, John H., Yard Master, Pennsylvania Railroad, Freeport, Pa. Recommended by G. J. Furch.

Miller, R. C., General Superintendent, Pennsylvania Railroad, Pennsylvania Station, Pittsburgh, Pa. Recommended by R. H. Flinn.

Patterson, F. W., Consulting Engineer, 1500 Third Avenue, New Brighton, Pa. Recommended by R. P. Forsberg.

Rhine, George B., Engine House Foreman, Pennsylvania Railroad, 104 Brownsville Road, Mt. Oliver, Pittsburgh, Pa. Recommended by H. G. Huber.

Rowles, H. N., Assistant Train Master, Pennsylvania Railroad, 2700 Broadway, South Hills, Pittsburgh, Pa. Recommended by H. G. Huber.

Schoch, M. G., Assistant Freight Train Master, Pennsylvania Railroad, Pennsylvania Station, Pittsburgh, Pa. Recommended by J. G. Dennis.

Sinclair, I. B., Superintendent, Pittsburgh Division, Pennsylvania Railroad, Pennsylvania Station, Pittsburgh, Pa. Recommended by J. G. Dennis.

Stein, J. A., Air Brake Instructor, Pennsylvania Railroad, Youngwood, Pa. Recommended by H. G. Huber.

Thornton, A. W., Resident Engineer, P. & L. E. R. R., Terminal Building, Pittsburgh, Pa. Recommended by F. J. Nannah.

White, Charles G., Supervisor, Aliquippa & Southern Railroad, 193 Clay Street, Rochester, Pa. Recommended by W. F. Ambrose.

PRESIDENT: These applications will be referred to the Executive Committee, in accordance with our By-laws, and upon approval by them the gentlemen will become members without further action of the Club.

SECRETARY: Since our last meeting we have received information of the death of the following members:

W. E. Magill, Division Freight Agent, B. & O. R. R., Pittsburgh, died December 28, 1931, and H. T. Porter, Chief Engineer, B. & L. E. R. R., died January 11, 1932.

PRESIDENT: An appropriate memorial minute will appear in the next issue of the Proceedings.

Is there any further business to come before the Club at this time? If not, we come to the paper of the evening. We have a very important subject before the Club this evening, the most progressive and modern subject for our attention. We are honored in having a very capable man of the United States Chromium Corporation of Pittsburgh to tell us about "Chromium Plating Applications in the Railway Industry", Mr. N. H. McKay, Metallurgist of that Corporation, whom I take great pleasure in presenting to you.

CHROMIUM PLATING APPLICATIONS IN THE RAILWAY INDUSTRY

By N. H. McKAY, Manager and Metallurgist, United States Chromium Corporation, Pittsburgh, Pa.

A few years ago chromium was one of the rare elements. Chromium has generally been classified with the other rare

elements particularly tungsten, molybdenum, vanadium and titanium.

Chromium is now one of the common metals. The market for chromium has been very good because the demand has exceeded the supply. In the case of the other rare elements mentioned, after a supply is found in nature it has been necessary to develop a market for this supply. The demand for chromium has come only within the past five to ten years. It is principally the advance of stainless and rustless alloys and also the advent of chromium plating which has offered this market for chromium. Until ten years ago very little chromium was used and the domestic supply of the raw material was adequate for our needs. Most of our domestic chromium was supplied from the Western United States, particularly California and Nevada. There was also a rather abundant supply of low grade material which was satisfactory for the manufacture of refractory brick. The demand for chromium today is such that it is necessary to import a large tonnage of chromite ore annually from Cuba, from several South American Countries and several Central American Countries and also from as far away as South Africa. The principal source of chromium today is Rhodesia in South Africa.

Chromium occurs in nature in the form of chromite of which I have a sample here and in which you may be interested.

Chromium—Commercial Supply

Industry cannot make use of chromite ore as such. For use in steel, chromite ore is reduced very similarly to the reduction of red hematite iron ore, to produce ferro-chrome. This ferro-chrome can readily be added and diffused through steel for alloy additions. I have here also samples of ferro-chrome and metallic chromium in which you gentlemen may be interested.

The chromium plating industry, rather than use any of these forms, uses a compound of chromium which is soluable in water and from which chromium can be electroplated. The sample which I have here shows the form in which we use chromium in the plating business.

Physical and Chemical Properties of Chromium

Chromium which we see in everyday life is used because chromium does not tarnish. This makes it of particular value for such applications as automobile trimmings and plumbing

fixtures. It is this property that has made it possible for chromium to replace both nickel-plating and silver-plating.

However, for the applications in which we are particularly interested tonight, there are other properties of the metal, chromium, which are far more important from our standpoint than the fact that it is non-tarnishing. We are particularly interested in the properties of chromium which permit it to serve the fields of wear resistance, corrosion resistance and heat resistance.

Let us first consider the field of wear resistance. The question of wear resistance is one of the most interesting problems that any engineers have before them today. The question always arises as to what material will best resist wear and how may wear resistance be predicted. There are no two problems on wearing surfaces which are exactly alike and in predicting the life of material there is only one thing on which to base our opinion and that is past experience—"history repeats itself". Resistance to wear covers a great many properties of matter. Hardness is generally taken as an index of wear resistance. Most studies of wear resistance have been tied up either with the Brinnell or Sceleroscope methods of hardness testing. However, for many kinds of operations all conditions and circumstances must be taken into consideration. There can be no such thing as an accelerated test, and it is a mistake to assume that a material which resists wear under one group of circumstances will act similarly in wear under different conditions. Why is it that rubber which is so soft will outwear steel in the lining of pipe or the lining of chutes. Why is it that the dripping of water day after day will wear away even the hardest stone. Why is it that our footsteps, soft soled shoes, will wear away the marble steps in these fine hotels and office buildings.

On the applications of chromium for resistance to wear, chromium brings into play not only its properties of hardness but also the fact that it has the lowest frictional resistance of all metals. Chromium has only approximately 30% the friction of steel. It presents a surface which remains smooth, clean and bright. These are a few of the reasons which explain its long life in a great many kinds of service.

To enumerate further on the hardness of chromium, we wish to quote from the Machinery Magazine which states as follows: "In a recent study of the scratch hardness of electro-deposited chromium, L. E. and L. F. Grant (of the Bureau of

Standards) confirmed previous observations that the hardest chromium is harder than any other metals or alloys thus far tested." We wish to present another study on the wear resistance of different gage metals which was studied by H. J. French, Senior Metallurgist, and H. K. Herschman, also of the Bureau of Standards, in which they show the wear resistance of different gage metals including nitrided nitrolloy, high speed steel, stellite and many different composition of tool steel in which the chromium plated gages show greatly more increased resistance to wear.

Because gages and tools represent some of the most extensive work which has been done on chromium plating, I wish to quote further with reference to the hardness of chromium. This quotation is from the Iron Trade Review which in turn quotes the Ford News of the Ford Motor Company which states as follows: "By the use of the plate, gages now are giving 218 hours of certain grinding operation where formerly four was the limit. Costs have been reduced more than half. Gaging applications that cost 8¼ to 9½ mills declined to 3½ to 4½ mills. Another example was the plug gage used on the small end of the connecting rod. Before it was plated, it could be used only about 1,300 times before it has to be resized because of wear; after plating, it was increased to 18,000 holes. The cost decreased from 3¼ mills for application to ½ mill. The wear allowed on this gage before scrapping is only 0.00005″." We also have note from one of the cost studies men at the River Rouge plant in which he summarizes as follows: "You will note that chromium plated plug gages give approximately seven times the life of tool steel plugs with the same corresponding reduction in cost, therefore I suggest that chromium plated plug gages be used exclusively on this part."

The hardness of chromium has always been of interest to our company. We have seen fit to develop a plating practice which gives the hardest possible chromium deposit. We wish to point out that the chromium plating which we are discussing at the present time must not be confused with that used for the plating of automobile fixtures or plumbing fixtures, in which case a mere flash of chromium is used to prevent tarnishing and which is used over copper and nickel-plating. In our work, the chromium is deposited directly upon the steel with a heavy hard plate. It is also deposited under conditions which make for hardness. Here, I wish to refer you to the Transac-

tions of the American Electro-Chemical Society, volume 56, to the article entitled "Effect of Current Density upon the Hardness of Electro-deposited Chromium" in which they show how plating conditions vary the hardness of the chromium. For example, they show how a plate thickness of .001″ of chromium deposited at a current density of 4 amperes per square inch will last forty-three times as long in service as the same plate thickness of chromium when deposited at a rate of only 1 ampere per square inch.

I would be glad to discuss the question of the hardness of chromium further if there is sufficient interest in the subject to prompt any questions. The one point which I want to leave with you on that matter is the hardness of chromium cannot be determined by either the Brinnell or the Sceleroscope methods but is measured with an abrasion machine which operates with a standard abrasive wheel at low speed to give abrasive wear rather than cutting or grinding and which operates under constant low pressure.

One of the strange points about the hardness of chromium is that although it is very hard yet it is very ductile. I am glad to show this point by demonstration methods with this piece of soft strip steel which is plated with a deposit of chromium on the one face which is so hard that it will cut glass or destroy file after file and yet is so ductile that it can be bent, twisted, hammered or even drawn without rupture of the chromium deposit.

Corrosion Resistance

The point of corrosion resistance might almost be taken for granted. It is the corrosion resistance of chromium which explains its non-tarnishing features which we see in the decorative finishes of chromium, inasmuch as tarnishing is a form of oxidation. It is also the corrosion resistance of chromium which prompted its use in the stainless and rustless alloys.

To emphasize further the corrosion resisting properties of the metal, chromium, I wish to enumerate three very severe applications which are out of the ordinary every day run of problems which you may have in the field of what you may call rusting. Chromium plating is used today in the manufacture of iodine. Iodine is one of the most corrosive materials ever discovered. Do you realize that the iodine with which you are familiar is a tincture or alcoholic solution of very dilute nature. Perhaps only 1% concentration of iodine? Imagine how corrosive this material would be with a 50% concentration.

Chromium is the only metal which has satisfactorily withstood the corrosive action of iodine.

A corrosion problem which would be a severe test on any metal is encountered in the mercury arc rectifier and in the mercury vacuum pump. Here again chromium plating has been refractory to the very corrosive conditions.

Another application which we have recently encountered is in the manufacture of ammonia. One of the advantages of chromium in addition to the fact that it is used here for corrosion resistance lies in the fact that shapes can be formed or machined from material which is easy to handle, for instance, from soft steel or other material which is very easily fabricated and then the wear resisting or corrosion resisting properties can be imparted to the relatively cheap material by chromium plating.

This point is very important from two angles, first reduced cost in fabricating or machining material which is relatively soft or easy to handle and second reduced cost through the use of ordinary inexpensive material which is merely faced with chromium rather than use expensive alloys which you pay for pound by pound at a high rate per pound.

Some of the other corrosion applications with which you are probably more familiar include pump parts, condenser and evaporator tubes, outdoor machinery, such as loading and handling crane equipment such as the ore docks at Lake Erie such as those at Cleveland, Conneaut, Ashtabula and Erie.

Here again I wish to stress the point that our company has seen fit to study the plating as particularly applied to corrosion applications. The requirements for complete corrosion resistance involve a great deal more than merely coating the piece with chromium. We have to deposit a plate which is very dense and non-porous.

You gentlemen probably realize that the chromium plating on your automobile bumpers or headlights or radiator shell is a mere flash of chromium, a matter of a few millionths of an inch in thickness. This deposit is porous. The rust resistance in the case of automobile trimmings lies in the fact that the steel is first plated with a heavy deposit of copper to prevent corrosion. The work is next nickel-plated to bring the color from the red of copper up to the silvery white color of chromium. After the piece is nickel-plated, it is chromium plated to present the non-tarnishing features. However, many of our industrial problems in corrosion call for more than resistance

to atmospheric corrosion, because the corrosion problems are coupled with wearing difficulties as well. For that type of application, you cannot use a soft metal such as copper and nickel underneath the chromium deposit, but a heavy deposit of hard chromium must be applied directly to the base metal.

To us in the chromium business, intelligent chromium plating involves more than the electro-deposition of the metal. We must have an intelligent understanding of the application itself, of the problem involved. We have in the Wilkinsburg Plant twenty-four large chromium tanks. Some of these are up to 25 feet in length. Some of the tanks are as much as 20 feet beneath the floor of the building. Our overhead crane capacity is good for as much as ten tons. Some of these tanks are designated for work involving the greatest hardness of chromium. Some of the tanks are prepared with solutions which have proved most effective in corrosion resistance. Other tanks are filled with solutions which are employed most effectively in the field of heat resistance.

Heat Resistance

The field for chromium at high temperatures is perhaps one of its greatest applications. The melting point of chromium is 1615° Centigrade or close to 3000° Fahrenheit. We have employed the use of chromium successfully in the manufacture of glass, both blown and pressed glass, in some cases where the temperature approaches 2000°. We have used chromium on blow pipes and puntys or gathering irons in molten glass, even on some of the high melting point glass, as high as 2400°, where the chromium has remained refractory to the very severe condition. This application was developed because all other furnace tools, many of them very expensive heat resisting alloys scaled into the glass, not only spoiling the glass but rapidly corroding away.

We have numerous furnace and high temperature applications for chromium. All applications for chromium in temperatures in excess of 1000° are limited to those which are corrosive in nature rather than those involving severe abrasion at high temperatures, such as hot rolling mill practice.

I have tried to stress that in addition to the wear resistance, corrosion resistance and heat resistance of chromium it also has the lowest coefficient of friction of any metal and also extreme ductility. There is another property which I wish to mention in passing because it has great application in chro-

mium plating, although you in the railroad business will have to decide for yourselves other applications in your work. I refer to the property of low surface tension. Translated into industry, we find it in the molding of rubber or molding of bakelite and celluloid, the molded products strip very easily from the molds. The rubber or bakelite does not stick to the molds and are easily removed with a clean bright finish. This is because the material does not wet the surface of the mold. The practice in the molding of rubber and bakelite in the past always necessitated the use of some such lubricant as soap, sulphur or linseed oil. We have eliminated the use of these lubricants. The same property is of great value in the baking industry in such equipment as dough mixers, chromium preventing the sticking of the dough to machinery and equipment.

RAILWAY APPLICATIONS

Maintenance of Way Department

In this department our work in the past has involved primarily the chromium plating of rail switch points. This application was introduced, not by ourselves as chromium engineers but by the railway men and it was a source of surprise to us that the application proved economical as we now see the case to be. Several years ago Maintenance of Way men decided to investigate the possibility of using chromium on rail switch points and placed some in test. I have here a picture of the first pair of switch points ever chromium plated. These points were ordinary open hearth rail steel and were cleaned at the points before chromium plating, the chromium deposit being on the order of .008″. These were placed in service in a busy track location in test tracks where accurate information had already been procured both as regards open hearth rails and manganese points. After the points had been in service approximately eight times the life of ordinary points, the railway supply concern wished to enter a contract for the installation of a plating unit at their plant. At this time, we suggested before going into it on a large scale a further investigation of the application in order to get a fair sized picture which would give us fair average results on which to base our judgment. Following this observation a large number of points were put in service on tracks of Eastern railways, most of them having in test at the present time twenty-five to fifty sets. The original points as shown in the photograph are the only points to have ever been removed from service after all this experience

and they were not removed until after serving approximately twelve times normal service or four times the service of a manganese point.

Other track applications which we are testing at the present time includes angle joint bars and frogs.

Car Applications

There is a tremendous amount of money to be saved through the use of chromium on car journals and axles. The field for chromium plating is so large that we cannot possibly keep up with it at the present time. The demand for it is far ahead of the supply. We are swamped with demands now. All industries are calling on us for service at the same time and some of them we have almost neglected. The car field is one of these but it represents an opportunity for saving a lot of money.

Motive Power

We have during the past four to five years been doing some work on loco wearing parts. We have had several tests run on main crank pins on which we have chromium plated the main rod and side rod fits. Our tests so far on main crank pins indicate that we can, by increasing the cost 30%, increase the life 300%. This takes into consideration the fact that a crank pin may have as many as four shoppings, each of which places the pin again in servicable condition.

The same ratio of economy is true in the case of cross head pins and knuckle joint pins. Other locomotive work which is in test at the present time includes side guide bars, valve motion and link motion parts. In the case of valve motion work, we chromium plate either the pins or the bushings, but not both, likewise in link motion, we chromium plate either the block or the link. You gentlemen will realize that in addition to offering these applications a hard wear resisting surface, you have very low friction, which is a tremendous advantage from a lubricating standpoint. Also a surface which remains clean, free from rust and dirt. Anyone in the audience who is acquainted with our work in the steel industry realizes how important is this point of a surface which remains clean, free from pick-up. This advantage is one which has given us such a hold on cold finishing rolls and dies for the drawing of seamless tubing.

The use of chromium on injector parts should be of tremendous interest to every railway man here. In the chromium

business today we are not trying to swap dollars. We are not even asking people to buy $2.00 worth of service for a dollar. In most of our work we can show that an investment of $1.00 will show a saving of four or five dollars. The use of chromium on injector parts shows such a saving. Parts which have been particularly good applications for the use of chromium are steam nozzles, intermediate nozzles, condensing nozzles and delivery nozzles also jet nozzles, combining nozzles, also lifter nozzles, lifter tubes forcer nozzles and forcer tubes. In some locations where these parts fail normally in from three to six weeks, chromium plated parts are still in service after a year's time. In other locations where the injector parts show a normal life of four to six months, chromium plated parts show very little wear after two years' service. From test information, reported to the writer, we are confident that ultimately chromium will be widely used on injector parts.

Reflectors

The U. S. Chromium Corporation delivered its first headlight reflectors in late 1926. Because these reflectors were delivered to test service rather than to the storekeeping department, we have had an excellent opportunity to observe the performance of these reflectors over a period of five years when they were periodically calibrated. The reflectors are as good today as when they were placed in service.

About two years ago, after we had found that the reflectors would give excellent service, we sold reflectors to nearly all Eastern roads.

The interesting points with reference to a chromium reflector are:

1st. It holds its brilliant reflecting surface without tarnishing. It maintains a bright surface which is not affected by either gases or sunlight.

2nd. The chromium has a high co-efficient of reflection. Figures which are about to be published will show that chromium today, in contrast with the early work on chromium, shows a co-efficient of reflection of approximately 90%.

3rd. Chromium reflectors have a true parabolic curve. It is specular reflection. There is no loss of light in passing through the medium such as lacquer or glass on silver due to refraction and absorption.

4th. It is non-breakable.

5th. Initial cost is about 60% that of competitive merchandise.

6th. In addition to considering the cost of the reflectors independently, the use of chromium reflectors eliminates certain other costly features in the headlight case.

7th. In the case of the use of prefocused sockets, it is generally conceded that the lamp life will be longer due to the resiliance of the metal.

In the past two years, we have placed in the neighborhood of 3,000 reflectors in service.

By way of summary, I wish to point out something which should be of considerable interest to you as members of the Pittsburgh Railway Club. What I have in mind is that although the commercial type of chromium finish such as we have on automobile trimmings or plumbing fixtures is quite widely practiced, yet the use of chromium for resistance to wear, resistance to corrosion and resistance to high temperatures, has been pioneered by one of your own members, Mr. Norman Allderdice, who has developed this activity. Mr. Allderdice, who organized the company something over five years ago and who as President of the Company, has always maintained an active interest in its operation, has made a scientific contribution to the reduction of waste in the many industries that chromium serves today. I mention this because this Club has every reason to be proud of that member who has brought Pittsburgh the reputation of being the home of the development of the uses of chromium in engineering applications.

I am glad to have as my guest this evening Mr. Harry F. Hitner, of the Pittsburgh Plate Glass Company, who has done as much work in the development of the uses of chromium to industry and the improvement of processes and methods of chromium plating as any man in the chromium plating industry. Mr. Hitner is one of the earliest workers in the art and has been active in the field of research as well as in the fields of commercialization of the process. To Mr. Hitner is due in particular the credit for the use of chromium on cast iron and the use of chromium at high temperatures.

Gentlemen, I thank you for your courteous attention.

PRESIDENT: You have heard a very comprehensive exposition of this new product, which Mr. McKay has certainly made very practical. The subject is now before you for general discussion. In view of the fact that this product is used

in automobiles and on railroads and in many other industries, we ought to have a very free discussion.

We would like to hear from Mr. H. F. Hitner, Electrical Engineer of the Pittsburgh Plate Glass Company first.

MR. H. F. HITNER: Gentlemen of the railway industry, I was considerably taken back by the kind words of Mr. McKay in reference to the little work I did on chromium plating six or seven years ago. I was particularly impressed with the tremendous amount of work Mr. McKay has done in this line.

I am particularly impressed because of the fact that with the small work I did seven years ago, it required over two years of step by step experimental work and tests and many disappointments before we obtained what little success we had. I think this will help us to appreciate the work Mr. McKay has done.

At this early date the automobile companies were just beginning to use chromium plating for automobile parts. I think the first automobile company had come out with only the radiator plated. At that time we were very much interested in getting rollers for our plate glass lehrs that would not corrode and not badly scale at a temperature of 1200° F. We were using 800 rollers at this temperature in a lehr. These rollers would be 6″ average diameter, the region plated 16′ long and the entire roller 20′. There was no alloy tubing at that time that could withstand this heat.

It looked like an attractive proposition to try chromium on low carbon steel tubing. We chromium plated, after considerable trouble, two or three rolls and they stood the heat very nicely for a period of six months. They had a plate of only 5/10,000″, which was all the plating we could obtain with this new process. We had already found that we could not do as the automobile companies did, we could not copper plate these rollers and then chromium plate over the copper, because as soon as the heat is applied the chromium would immediately scale off.

After some experimenting, we were able to plate the chromium directly on the steel. After half a dozen experiments, results looked good, and to make a long story short—after two years of work we had come to the point where we were able to plate .005″ on a roller of this kind, making it .01″ larger in diameter. By a process which has been slowly developed, we could get perfect adhesion to the steel. Some of

these rollers placed six years ago are still in operation, seemingly absolutely unchanged in all that period.

Furthermore, that roller that cost possibly $20.00 to chromium plate, plus the initial cost of the standard steel tube machined and ready to plate $60.00, the total cost would be $85.00. The roller made out of stainless steel tubing would not be nearly as good and would cost $300. When you consider even 500 rollers to a lehr, this is a considerable saving, particularly as the chromium plated tube is better than any steel previously used for that purpose.

I was greatly interested in making comparison with the small job I did; the long time taken; and the tremendous amount of work to obtain results, to hear how Mr. McKay has gone through a hundred different development processes of that kind, both in protection and hardness plating, and has had many difficulties to encounter. Incidentally he did not take two years to do any one of them.

His talk tonight has enabled me to appreciate the tremendous amount of work Mr. McKay has done and yet the work is absolutely in its infancy. It is a very husky infant.

There are some of these processes which now show very considerable advance over our first tests and as they become standardized, as will be necessary for reliability and economy, they will certainly come into commercial use. It is difficult to appreciate what a great field there is before us in this development.

PRESIDENT: Mr. H. W. Jones, General Superintendent of Motive Power, P. R. R., in the use of reflectors, crank pins, may we hear from you?

MR. H. W. JONES: I have been very much interested in Mr. McKay's talk tonight. There is just one question I would like to ask, and that is, what effect, if any, does chromium plating have on heat treatment?

MR. McKAY: As far as the effect of chromium plating on the heat treatment is concerned, this is a matter that has brought us a lot of business. We used to go out into the machine shops in Pittsburgh and tell the shop men that it was mighty nice of them to grind their roll necks or journals too small. The shop men didn't like that way of putting it so now we tell them "Thank God we can save these rolls for you." We have a nice business in the reclamation of parts accidentally

machined or ground undersize, or perhaps machined oversize on inside diameters, and one reason that we have this business answers Mr. Jones question, that we do not alter the heat treatment of the part. It would be impossible to reclaim these parts by welding methods because the welding temperature would influence the heat treatment, whereas chromium plating is done at room temperatures.

MR. JONES: What I had in mind was the cross head pin, the plating of the bearing portion of cross head pins with the thread end, would chromium plating have any effect at the line of demarcation.

MR. McKAY: You mean part heat treated and the other part not heat treated.

MR. JONES: That is right.

MR. McKAY: There would be no objection to chromium plating such a piece.

PRESIDENT: Mr. S. B. Pickard, Chief Electrician, P. & L. E. have you anything to offer?

MR. S. B. PICKARD: I haven't had any experience in chromium plating except in reflectors. I want to say about these reflectors that we have some that have been in use for eight months and they have stood up fine so far. They stand up where the silver reflectors do not. In about three months time the silver reflectors would drop to about 20% of its original effectiveness. In other words if it had a pick up at 1000′ with a 250 watt lamp, in three months time it will drop to 800′, which is all we are allowed. But with chromium plate reflectors they will still stand up to about 900′ and it is still 900′ at the end of eight months. Glass reflectors after six months will also drop back and continue to do so, after it is in service for about a year or 18 months it will drop back to about 800′. When it is in two years it still keeps on dropping back to about 700′. We have not had enough experience with Chromium reflectors as yet for they have not been in but eight months.

MR. McKAY: A chromium reflector is the only permanent non-tarnishing reflector. Reflectors calibrated for beam candle power in 1926, after five years in constant road service still show no loss in reflectivity. The 900′ which Mr. Pickard mentioned for chromium is taken from old silver-plated reflectors which

were replated with chromium. With our own reflectors, designed to hold contour, we have no difficulty maintaining a figure of 1200′.

MR. PICKARD: I would like to ask, what is the maximum thickness of chromium plating you can put on crank pins, etc.?

MR. McKAY: Generally, the economic limit of thickness of chromium plate is reached before the operating limit. We have, however, plated to a thickness of .165″ on one reclamation job. This is the heaviest deposit of chromium plating which has ever come to my attention.

MR. PICKARD: A journal pin in a locomotive, how much plating do you put on that?

MR. McKAY: We increase the diameter by .016″ of chromium.

MR. PICKARD: If a pin is ground out of round, can it be plated only where it is off true?

MR. McKAY: It can be done but it would be a big expense. The best way to do is to plate it all over and then regrind it carefully on its original centers which will leave the chromium on the desired areas.

MR. PICKARD: Does the grinding effect the hardness of the chromium?

MR. McKAY: No.

PRESIDENT: This is getting interesting. Mr. Howard, Chief Engineer, Union Switch & Signal Company, may we hear from you?

MR. L. F. HOWARD: I don't know anything about it. There is, however, one question I would like to ask. In plating small parts of complicated shape, such as the bakelite moulds you mentioned, how do you get the chromium to "throw" evenly on the different surfaces of the mould? Do you have to make an anode conforming to the shape of the article to be produced by the mould in order to get even distribution of the plating on the complex surface?

MR. McKAY: The making of an anode such as you suggest is necessary in order to provide uniform thickness of the

deposit. You must have uniform current distribution as the ordinary tendency of the chromium plating is to seek the high points, just like lightning to a lightning rod.

MR. L. H. FRY: Mr. McKay spoke of plating valve motion parts, where one part is plated and the part against which it wears is not, what effect does the plating have on the wear of the unplated part?

MR. McKAY: The reason we plate only part is because we find by having a very hard surface and very low friction on the plated part it keeps down wear on the unplated part. By maintaining a hard glass-smoothed surface on the chromium plate we also reduce the wear on the opposite part. It is necessary, however, to have a very high finish underneath the chromium plate because every rough spot in the steel would be reproduced in the chromium plate and that would then have file action.

MR. L. G. VAN WIE: I would like to ask Mr. McKay about the tendency to carbon accumulation, whether this plating would have any effect on a tendency of that kind.

MR. McKAY: Do you mean does the chromium plating stop the formation of carbon on the piston?

MR. VAN WIE: I have in mind more than the pistons. To prevent carbon forming on the top of the pistons.

MR. McKAY: We have done no work in plating the faces of pistons for automobile use. We have done it for Diesel engine work. Also in cylinder liners. One of the pictures presented a pair of cylinder liners. As far as your question is concerned specifically, I believe it would have a tendency to reduce the formation of carbon on the plated surface. We have seen it work on cylinder heads which have exhibited that tendency. Even under relatively poor combustion conditions I believe this would be true, any carbonaceous material, any residue, would have a tendency to be blown out of the engine due to the non-sticking tendency of the chromium surface.

MR. L. O. GRONDAHL, (Union Switch and Signal Company): I was very much interested in what Mr. McKay said about the effect of chromium plating on switch points. I am under the impression that the degree to which chromium plating stands up against wear in such conditions depends on the hardness

of the surface on which it is plated. I am wondering if in the case of switch points it deforms with the steel underneath or whether it prevents deformation.

MR. McKAY: A surprising thing about chromium is the fact that compared with its extreme hardness—I have some pieces of sheet metal here which are so hard that they will dull a file, and yet you can readily bend them. They can be drawn without breaking. This material is sufficiently ductile to flow. In the case of switch points, though our information is not complete as yet, what we think takes place is really two things. We believe from the observations we have made up to the present time that some of the chromium is actually rolled into the mild steel, really rolls into the structure of the steel itself, so that we have a mechanical impregnation of the chromium which has a tendency to reduce friction and increase resistance to abrasion. The other point is that we believe that in the flow of the metal, the chromium will not do anything to resist the flow. We believe that in the wear which takes place in these switch points. really there is some underflow of the steel so that, that which is being sheared off the switch point is really coming from underneath the surface rather than the cutting away of the surface.

PRESIDENT: Mr. Paisley, Inspecting Engineer, P. & L. E., will you say anything in connection with frogs and switches?

MR. F. R. PAISLEY: Mr. President, as to switch points, I was with the Chromium Corporation last fall and I was very much interested in the information I got at that time, which was just about what Mr. McKay has given us tonight. I will be interested in getting their further returns from these experiments.

MR. VAN BLARCOM: I would like to ask Mr. McKay with regard to these switch points if he could give us the coefficient of friction of chromium plated points as compared with manganese points and with carbon steel points.

MR. McKAY: As far as published information goes the relation between the coefficient of friction of chromium and steel for similar degree of finish on the surface indicates that steel has a coefficient of in the neighborhood of .30 to .36, where in the same scale chromium is shown from .10 to .12. In the case of switch points, all chromium plated points are ground before they are chromium plated. The scale must be removed. In the

case of your ordinary points, they go right into service without this operation. The difference in the coefficient of friction in this case would be even more extreme than approximately 30%.

PRESIDENT: Mr. Endsley, may we hear from you?

PROF. L. E. ENDSLEY: We have listened to a very interesting story and discussion tonight, and that story has been well told and I have no doubt that the Railway Club of Pittsburgh will again go down in history with a paper which is a pioneer in the field of industry, this time in the field of chromium plating. So, Mr. President, I would like to move you that this meeting by a rising vote of thanks express to Mr. McKay the appreciation of this Club for this very excellent discussion of chromium plating.

The motion prevailed by unanimous vote.

There being no further business,

ON MOTION the meeting adjourned to the luncheon tables.

J. D. CONWAY, Secretary.

In Memoriam

W. E. MAGILL,

Died, December 28, 1931.

H. T. PORTER,

Died, January 11, 1932.

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Federal Bureau of Locomotive Inspection and Its Relation to Locomotive Maintenance

By A. G. PACK, Chief Inspector, Bureau of Locomtive Inspection, Interstate Commerce Commission.

OFFICIAL PROCEEDINGS

OF

The Railway Club of Pittsburgh

Organized October 18, 1901

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Past Presidents

*J. H. McCONNELL	October, 1901, to October, 1903
*L. H. TURNER	November, 1903, to October, 1905
F. H. STARK	November, 1905, to October, 1907
*H. W. WATTS	November, 1907, to April, 1908
*D. J. REDDING	November, 1908, to October, 1910
*F. R. McFEATTERS	November, 1910, to October, 1912
†A. G. MITCHELL	November, 1912, to October, 1914
*F. M. McNULTY	November, 1914, to October, 1916
J. G. CODE	November, 1916, to October, 1917
*D. M. HOWE	November, 1917, to October, 1918
*J. A. SPIELMANN	November, 1918, to October, 1919
H. H. MAXFIELD	November, 1919, to October, 1920
FRANK J. LANAHAN	November, 1920, to October, 1921
SAMUEL LYNN	November, 1921, to October, 1922
D. F. CRAWFORD	November, 1922, to October, 1923
GEO. D. OGDEN	November, 1923, to October, 1924
A. STUCKI	November, 1924, to October, 1925
F. G. MINNICK	November, 1925, to October, 1926
G. W. WILDIN	November, 1926, to October, 1927
E. J. DEVANS	November, 1927, to October, 1928
W. S. McABEE	November, 1928, to October, 1929
E. W. SMITH	November, 1929, to October, 1930
LOUIS E. ENDSLEY	November, 1930, to October, 1931

*—Deceased.
†—Resigned.

Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING
FEBRUARY 25, 1932

The meeting was called to order at the Fort Pitt Hotel at 8 o'clock P. M., with President J. E. Hughes in the chair.

There were 454 registered in attendance as follows:

MEMBERS

Adams, W. A.
Allinger, N, J.
Altsman, W. H.
Ambrose, W. F.
Anderson, G. S.
Anthony, R. H.
Ashley, F. B.
Babcock, F. H.
Baer, H. L.
Bair, J. K.
Bald, E. J.
Balzer, C. E.
Barr, H. C.
Beeson, H. L.
Berg, K.
Berghane, A. L.
Bonhoff, E. L.
Braun, O. F.
Brewer, H. W.
Buckwalter, T. V.
Callahan, F. J.
Campbell, J. E.
Cannon, T. E.
Carlson, L. E.
Carmack, J. L.
Carson, John
Chalker, A. R.
Conway, J. D.
Cotter, G. L.
Courtney, H.
Craig, W. J.
Crenner, J. A.
Cromwell, H. T.
Cunningham, J. L.
Cunningham, R. I.
Cunningham, W. P.
Dambach, C. O.
Davies, James
Davis, Charles S.
Davis, John W.
Dalzell, W. E.
Dempsey, P. W.
Devans, E. J.
Diven, J. B.
Donovan, J. J.
Down, S. G.
Downes, D. F.
Dunbar, Harold F.
Edwards, C. H.
Emery, E.
Emsheimer, Louis
En Dean, J. F.
Endsley, Prof. Louis E.
Evans, David F.
Finegan, L.
Fisher, E. M.
Fitzgerald, T.
FitzSimmons, E. S.
Flannery, J. Rogers
Forsberg, R. P.
Fowler, J. C.
Frauenheim, A. M.
Freshwater, F. H.
Fritz, A. A.
Furch, G. J.
Gardner, J. E.
Gatfield, Phillip A.
Geddes, James R.
Gellatly, William R.
Germak, George A.
Gilg, Henry F.
Glaser, J. P.
Glenn, J. H.
Goda, P. H.
Gray, C. B.
Grieve, Robert E.
Grimshaw, F. G.
Hackett, C. M.

Haller, Nelson M.
Hamilton, W. H.
Hanna, R. B.
Hansen, William C.
Harper, J. T.
Hastings, W. S.
Hayward, Carlton
Henderson, George L.
Henry, C. L.
Herrold, A. E.
Hilstrom, A. V.
Holmes, E. H.
Honsberger, G. W.
Hoover, J. W.
Huber, H. G.
Hughes, John E.
Huston, F. T.
Jackson, W. M.
Jenkner, Oscar
Jones, H. W.
Keenoy, R. P.
Keller, Ralph E.
Kelly, H. B.
Kennedy, A. R.
Keys, A. H.
Klein, N. P.
Kraus, Raymond E.
Kroske, J. F.
Kruse, J. F. W.
Kummer, Joseph H.
Lackner, R. A.
Laughner, C. L.
Leach, J. T.
Lee, L. A.
Leet, C. S.
Lehr, H. W.
Lewis, Herbert
Loeffler, George O.
Long, R. M.
Lowry, William F., Jr.
Luddy, W. E.
Lynn, Samuel
Maliphant, C. W.
Marquis, G. E.
Masterman, T. W.
Meinert, Henry J.
Mercer, B. F.
Merscher, John
Millar, C. W.
Miller, J. F.
Mills, C. C.
Mitchell, F. K.
Mitchell, W. S.
Misner, G. W.
Moir, W. B.
Morgan, A. L.
Morgan, Homer C.
Morris, A. T.
Myers, Arnold
Myers, B. E.
Myers, R. C.
McCauley, William
McGeorge, D. W.
McHugh, C. A.
McKenzie, Edward F.
McKinley, A. J.
McKinley, John T.
McKinstry, C. H.
McIntyre, R. C.
McMillan, A. P.
McNamee, W.
McQuillen, J. J.
Neff, John P.
Nieman, Charles J.
Noble, Jesse A.
Norris, J. L.
Nutt, Col. H. C.
O'Leary, J. J.
Orchard, Charles
Orr, D. K.
O'Sullivan, J. J.
Palmer, E. A.
Parker, William, Jr.
Pickard, S. B.
Prince, Albert
Pringle, H. C.
Pringle, Paul V.
Ralston, J. A.
Rankin, B. B.
Rauschart, E. A.
Ream, A. H.
Redding, P. E.
Redding, R. D.
Reeve, George
Renshaw, W. B.
Reynolds, D. E.
Rhine, G. B.
Richardson, H. R.
Robinson, R. L.
Roth, Philip J.

Rowles, H. N.
Ryan, Frank J.
Sample, W. E.
Sattley, E. C.
Schaffer, W. E.
Schmitt, Raymond F.
Schoch, M. G.
Schrader, A. P.
Schubert, C. F.
Schultz, D. C.
Seibert, W. L.
Seiss, W. C.
Severn, A. B.
Shafer, J. S.
Sharp, James
Shellenbarger, H. M.
Sheridan, T. F.
Smith, H. K.
Smith, J. Frank
Snyder, F. I.
Spinning, Charles F.
Stearnes, Leo C.
Stearns, William G.
Stephen, James
Sterling, C. C.
Stevens, L. V.
Stevens, R. R.
Stewart, L. R.
Stillwagon, C. K.
Stine, D. H.
Stoecker, P. J.
Sutherland, Lloyd
Swope, B. M.
Thomas, H. N.
Thomas, Theo.
Tipton, G. M.
Tomasic, N. M., Jr.
Tucker, J. L.
Tucker, J. W.
Uhar, John J.
Van Blarcom, W. C.
Van Horn, Ivan L.
Van Vranken, S. E.
Van Wormer, G. M.
Walther, G. C.
Warfel, John A.
Watt, Herbert J.
Weaver, W. Frank
Webster, H. D.
West, G. S.
Wheatley, William
Wheeler, C. M.
Whipple, A. L.
Wilharm, J. H.
Winslow, S. H.
Woodward, Robert
Wright, John B.
Wright, O. L.
Wyke, J. W.
Wynne, F. E.
Yarnall, Jesse
Zammikiel, John
Zilian, R. F.

VISITORS

A'Hearn, F. M.
A'Hearn, Thomas F.
Albright, R. M.
Balslug, J. L.
Barnett, J. W.
Barth, W. H.
Bates, J. H.
Bayer, Carl
Becker, John H.
Beam, W. H.
Berger, John S.
Betz, C. H.
Bisi, C. W.
Brenaman, H. A.
Bronder, N., Jr.
Brown, Robert J.
Browning, F. R.
Bruce, B. L.
Butler, J. H.
Butler, J. W.
Caldwell, S. S.
Carey, J. L.
Carlson, H. A.
Carroll, J. P.
Coenraets, L.
Cogelsong, W.
Coleman, G. H.
Callin, T.
Conlin, James
Connelly, W.

Cook, E. S.
Cooper, R. F.
Cotton, C. S.
Crawford, Edmund M.
Crawford, William J.
Crouser, C. S.
Culan, John A.
Cunningham, H. B.
Curry, J. L.
Cuthbert, Charles
DeVilbiss, E. B.
De Walt, G. H.
Dickson, K. B.
Diufel, W.
Downing, N. H.
Dudley, H. A.
Dunkerly, E. R.
Earnest, F. M.
Edmondson, O. N.
Eilmon, William
Eller, G. C.
Everstine, A. P.
Ewalt, Raymond
Flannery, E. S.
Forrester, James B.
George, W. J.
Germerodt, George N.
Germerodt, Howard E.
Gillespie, Porter
Girty, E. C.
Gollmer, H. C.
Goodwin, Arthur E.
Griffin, G. P.
Hogg, Albert L.
Haggerty, J. F.
Harbaugh, C. P.
Harner, J. H.
Harris, O. G.
Haupt, H. H.
Healy, John
Heep, Charles W.
Herley, J. E.
Hicks, L. W.
Hill, George
Himmelright, R. J.
Hodges, A. H.
Hoffman, E. H.
Hoover, R. W.
Horger, Oscar J.
Huff, A. B.
Hunt, C. T.
Johnson, J. D.
Johnson, J. L.
Johnson, R. S.
Jones, B. E.
Jones, George
Joyce, Stephen
Kelker, J. F.
Kelin, A. W.
Kenten, George A.
Kentlein, John
King, J. W.
Klassen, F. G.
Koontz, C. R.
Kramer, F. E.
Kulp, J. G.
Lambert, G. J.
Larson, W. E.
Laughlin, H.
Layton, J. L.
Lee, C. J.
Leech, George R.
Lehman, C. B.
Lehr, W. E.
Lewis, S. B.
Long, H. M.
Lund, G. E.
Lyons, P. W.
Macoubray, R. J.
Maginn, J. J.
Malcolm, H. W.
Maloney, J. J.
Martin, B. J.
Martin, R. M.
Melton, J. W.
Miller, George
Millige, E. W.
Mitchell, John B.
Morse, F. L.
Morse, J. W.
Moschbye, F. M.
Mowery, F. J.
Mumaw, G. H.
Mycoff, G. H.
McBird, L.
McCleary, G. T.
McDermott, John P.
McGann, C. E.
McKalby, J. P.
McMurray, C. H.

Nettrous, W. S.
Newell, J. P., Jr.
Noble, H. S.
Nowell, R. H.
Noyber, P. G.
O'Donnell, R. E.
O'Neil, Thomas
O'Reilly, James A.
Osbourne, C. J.
Pack, N. E.
Pack, A. G.
Patton, C. F.
Peck, E. A.
Peters, E.
Pfohl, W. G.
Piper, G. D.
Powell, H. C.
Prendergast, A. P.
Redden, James A.
Reithel, Benjamin H.
Reynolds, A. C.
Rhodes, R. W.
Richards, J. S.
Richardson, E. F.
Rick, R. C.
Robinson, G. H.
Ryan, James M.
Sable, R. C.
Sanders, George
Schane, C. W.
Schurlin, L. J.
Schrontz, S. B.
Scott, Wylie
Seiler, H. A.
Sekera, C. J.
Shepherd, W. B.
Shirley, John A.
Shourek, Theodore L.
Shull, C. O.
Sloan, J. R.
Smith, F. C.
Smith, G. M.
Smith, L. S.
Smith, R. W.
Smith, Sion B.
Snitehurst, J. H.
Spaith, W. F.
Spinnenweber, John
Spotts, A.
Stark, Joseph A.
Steen, W. E.
Steindoerfer, W. A.
Strachan, C. J.
Stuckmen, A. C.
Suffern, R. J.
Suthenic, H. B.
Thomas, George P.
Thompson, L. D.
Thomson, J. H.
Thulin, C. T.
Trax, Louis R.
Tripp, W. N.
Tryon, C. N.
Uhlrich, C. H.
Vandivort, R. E.
Van Schaick, F. L.
Vollmer, Walter K.
Waltoc, E. F.
Waxman, J. H.
Williams, E. R.
Williamson, J. A.
Wolf, Joseph
Woods, G. Mc.
Wray, R. W.
Yeardley, Harry
Zacharias, F. F.
Zajicek, John J.
Zink, Joseph P.

As an introductory Miss Maude Ingersoll presented a five-piece Ladies' Orchestra and all joined in popular old songs.

PRESIDENT: The call of the roll will be dispensed with as the record of attendance is taken care of by the registration cards.

If there is no objection, we will dispense with the reading of the minutes of the last meeting, as the printed Proceedings are already in your hands.

The Secretary will now read the list of proposals for membership.

SECRETARY: We have the following proposals for membership:

Ernest, E. E., Superintendent Passenger Transportation, Pennsylvania Railroad, Pennsylvania Station, Pittsburgh, Pa. Recommended by R. H. Flinn.

Hosford, Charles C., General Scale Inspector, Pennsylvania Railroad, 6625 Ohio River Boulevard, Ben Avon, Pa. Recommended by J. E. Hughes.

Hubacher, O. H., Locomotive Engineer, P. & L. E. R. R., 914 Broadway, McKees Rocks, Pa. Recommended by G. M. Van Wormer.

Hughes, I. Lamont, President, Carnegie Steel Company, Carnegie Building, Pittsburgh, Pa. Recommended by L. C. Bihler.

Hursh, P. S., Supervisor Boilers, B. & O. R. R., 17 Linden Avenue, Du Bois, Pa. Recommended by E. S. FitzSimmons.

Johnston, C. DeLos, Chief Clerk to Assistant Superintendent, P. & L. E. R. R., 370 Dravo Avenue, Beaver, Pa. Recommended by J. E. Hughes.

Kulp, J. G., Train Master, Pennsylvania Railroad, 1207 Savannah Avenue, Edgewood, Pittsburgh, Pa. Recommended by H. G. Huber.

Sekera, Charles J., Tester, Engine Department, Westinghouse Air Brake Company, 437 Short Street, East McKeesport, Pa. Recommended by C. H. McKinstry.

Trax, Louis R., Clerk, Union Railroad, 416 Montview Place, Wilkinsburg, Pa. Recommended by R. C. McIntyre.

PRESIDENT: In accordance with our By-laws these applications will be referred to the Executive Committee, and upon approval by them the gentlemen will become members without further action of the Club.

The Secretary announced the death, since the last meeting, of Mr. F. A. Ogden, General Freight Agent, Jones & Laughlin Steel Corporation, who passed away on February 1, 1932.

PRESIDENT: An appropriate memorial minute will appear in the next issue of the Proceedings.

PRESIDENT: On February 22, 200 years ago, there was born an American hero, George Washington, whose fame is not wholly accounted for by the record of his life. He lived and died without ever hearing of the agency that was to bring about the most impressive development of the United States. That agency was American railroading, the first example of which came thirty years after Washington's death.

George Washington encouraged the development of interior transportation. He organized and headed a company for the improvement of the Potomac River. Yet at his death, after the United States had been the beneficiary of nearly two centuries of highway and waterway transportation, commerce was meager and difficult. Then came the railroads. It is no mere coincidence that the United States and the railroads grew together.

In commemorating the birth of this great man, whose likeness appears before you tonight, we are exceptionally honored in having with us a man who is a member of this Club and who occupies a prominent place on the Club roster. This member was born and reared in Washington's State, Virginia. He took up as his life's work the same vocation as the father of our country, Engineering, and is very successful in this vocation. It is a pleasure to present to you Mr. R. P. Forsberg, Chief Engineer of the Pittsburgh & Lake Erie Railroad, Pittsburgh, Pa.

Commemorating the Two Hundredth Anniversary of the Birth of George Washington

By R. P. FORSBERG, Chief Engineer,
Pittsburgh & Lake Erie Railroad Company, Pittsburgh, Pa.

Mr. President, Members of the Railway Club of Pittsburgh and Visitors: I desire to assure you of my most profound gratification at the receipt of your invitation to take some small part in that portion of the evening's program that has been dedicated to the commemoration of the Two Hundredth Anniversary of the birth of George Washington.

You have, Mr. President, most graciously referred to the fact that because I also am a Virginian it was deemed fit that I should act as Spokesman upon this occasion. With all my heart I wish that one more worthy, and one more competent, had been selected. It is true that Washington was a Virginian, but he later became

an American and I shall think of, and refer to him as such, in the few minutes that I have at my disposal.

Two hundred years ago, on the banks of the Potomac River in Westmoreland County, Virginia, on a spot marked today only by a memorial stone, a son was born to Augustine and Mary Washington. Not many miles above his birthplace is the dwelling where he later lived, and near which he now lies buried. The white porch of that old colonial home flanked by groves and gardens, a shrine for many a pilgrimage, is a familiar sight to every American school child.

It is very meet and right and proper that we, as citizens of Pittsburgh, should take more than a passing interest in the bicentennial celebration of the birth of the Father of our Country, for the occasion very properly recalls that he was deeply interested in this section, having paid seven visits to the Pennsylvania counties west of the Alleghenies during his lifetime.

Washington first came to Western Pennsylvania in 1753 for the purpose of delivering to the French commander a writ of eviction, signed by Governor Dinwiddie of Virginia. The Pittsburgh District, known in the early days as the "Forks of the Ohio" was claimed by both the Pennsylvania and the Virginia colonies, as well as by England and France, resulting in intercolonial and international rivalry. Governor Dinwiddie saw all too clearly that as a result, a war with France was inevitable and he selected the young Washington as his emissary to the French commander. Just twenty-one years of age, Washington, a woodsman, surveyor, student of military tactics, and an aristocrat well advised relative to the delicate courtesies in treating with the French commander, started with his embassy on his first mission West.

Arriving at the mouth of Turtle Creek, on the Monongahela River, he learned the French were in winter quarters, and crossed overland to the Allegheny River at Shannopinstown (near Lawrenceville) and rode to the Point along what is now Butler Street and Penn Avenue, passing undoubtedly over the very plot of ground upon which this building is located.

Time prevents our following his further movements in any detail; but five years later, commanding the Virginia troops under the leadership of General Forbes, we find him advancing on Fort Duquesne. An attempted raid on Fort Duquesne by Major Grant for intelligence purposes, known as the battle of "Grant's Hill," resulted in a crushing defeat for the British. As cold weather

advanced the troops of General Forbes became despondent, until word came that the French were preparing to evacuate the Ohio Valley.

Forbes ordered Washington to push ahead and cut a road for an immediate advance. On November 28, 1758, Washington wrote Governor Fauquier, "I have the pleasure to inform you that Fort Duquesne, or rather the ground on which it stood, was possessed by his Majesty's troops on the 25th instant." With the close of the Forbes campaign, Washington, just twenty-six years of age, left the newly named Fort Pitt, the fort from which the edifice in which we meet tonight derived its name, through forever, as he hoped and prayed, with war.

Mount Vernon welcomes back the distinguished soldier. Domestic felicity spreads its charms around him, as he takes to his side the wife of his choice and dreams of a life of unsevered happiness. And the quiet years roll by as he superintends his plantation, ships his crops, posts his books, and for amusement chases the fox.

But alas for his Elysium dream. The air becomes pregnant with the seeds of revolution. The Mother Country has initiated the fatal policy of taxing her Colonies without their consent, and the Revolutionary War ensues.

Time forbids nor does necessity require our tracing his course through that dread struggle, for it is a story familiar to each one of us.

What was his greatest achievement, what was the crowning event in his life? For my part I am unprepared to answer. But I do not believe that many, if any, of his acts demanded greater personal fortitude nor were of higher value to the struggling Colonies than the courage he displayed in the winter quarters, on Pennsylvania soil, at Valley Forge. Every student of history is familiar with the suffering and the unthinkable privations experienced by the little band of patriots through that dread winter, and we believe their patriotism was kept alive wholly as the result of the personal courage and the unparalleled example of devotion to duty displayed by Washington. It is perfectly plausible to believe that had he failed during those dark days, had he then given up the struggle that the subsequent history of our beloved land would have been wholly changed.

Gentlemen, if the observance of the bicentennial of the birth of this great character results in awakening in you and awakening in me a new sense of our obligation to our Government, a recon-

secration of our efforts to uphold and sustain it, a rededication of our very selves to the ideals that he enunciated and so nobly lived, this celebration has not been held in vain.

Patriot, Soldier, Statesman, Sage, Rebuilder of Creeds, Teacher of Truth, Dispenser of Justice, Achiever and Preserver of Liberty, Founder and Savior of his Country. We thank Thee, O God, that Thou in Thy all wise and infinite providence didst give to America, George Washington.

PRESIDENT: Gentlemen, let us rise and sing one verse of our national anthem, "America."

PRESIDENT: By reason of the very close acquaintance that Mr. Flannery has with the speaker of the evening, I have asked Mr. Flannery to introduce to you the speaker of the evening.

MR. J. ROGERS FLANNERY: Mr. Chairman, Members of the Railway Club of Pittsburgh and Guests: I am going to let you into a secret. We are having a little industrial depression at this time. But I wonder if all of you realize that one-sixth of all the products that are sold in this country are purchased by the railroads of the United States. And I also wonder if you realize that the railroads, in every cycle of depression, have been the first to set the wheels of industry rolling again toward normal operation. So that we are all vitally interested in the railroads. And the public and the railroads are naturally interested in seeing that the railroads are kept in good shape. The United States Government uses the Bureau of Locomotive Inspection of the Interstate Commerce Commission as the medium through which to see that the locomotives are kept in good condition, because, after all, the locomotive is the heart, the thing that gives the power to help transport passengers and freight throughout the country, bringing revenue to the railroads and prosperity to this country.

So that the Bureau of Locomotive Inspection really has a very serious responsibility because the Chief of that Bureau happens to be the contact point between the government and all the railroads in this country in that particular branch of the work. Now every individual and corporation resents very much newly imposed laws that more or less restricts their operation, and I think it is marvelous the manner in which the Chief of the Bureau of Locomotive Inspection, Mr. A. G. Pack, and the railroad officials of this country have co-operated in working out the govern-

ment inspection rules, respecting the judgment of each other, and always acting with an equitable acknowledgment of the rights of everybody concerned in the particular work they are doing.

I have known Mr. Pack for many, many years and I have followed his career with a great deal of interest, because in my opinion Mr. Pack is the type of government official that today we can be very proud of. In these days of stress, when every corporation is attempting to economize in every way and all officials are under tension he does not go into a fit of hysteria nor publicly voice violent pronouncements against railroads that may have consciously or unconsciously broken certain rules regarding locomotive equipment. In his quiet way he goes to the railroads, lays the facts before them, and they get together and the thing is adjusted. To my mind he is one of the most lovable men in Washington. I spent two years in Washington during the war and it was always a pleasure to go up to his office and get into that quiet atmosphere away from the turbulence and chaos in which many of the hurriedly organized temporary governmental departments were struggling.

Mr. Pack, as you know, has been head of the Locomotive Inspection Bureau since before the war and he has built up a department that I think is a model for many other departments of the government to follow. It is efficient, it is thorough, and it is 100 per cent on the job all the time. And the man himself, who has come up from the ranks—as all good men do—is so courteous and considerate and kind that many a time when any of us has presented problems which he has decided against us he has been so pleasant in his manner of deciding adversely that we get up with a smile, thank him and shake hands with him when we leave. So that I think Mr. Pack typifies what is absolutely essential in the relations between the government and public and semi-public corporations. He is a friendly type of man, and has the good of the railroads at heart. He insists upon the requirements of the government being carried out, but with appreciation of the fact that the railroads should be put to the least cost necessary in complying with same. He and the railroads today are trying to work out preventative policies, not permitting things to run to such an extent that a drastic course of action may become necessary. I hope Mr. Pack remains for many years the head of his present department, because when he leaves I believe the railroads of this country will lose a factor that is very helpful in maintaining that spirit of friendly co-operation.

Therefore it is a great pleasure and privilege for me to present to you Mr. A. G. Pack, Chief Inspector of the Bureau of Locomotive Inspection of the Interstate Commerce Commission.

MR. A. G. PACK: Mr. President, Members of the Railway Club of Pittsburgh, and Guests, Friends: I am very sorry that I do not feel that I can quite measure up to the standard Mr. Flannery has set for me. However, I am going to do the best I can to live up to it.

Federal Bureau of Locomotive Inspection and Its Relation to Locomotive Maintenance

By A. G. PACK, Chief Inspector,
Bureau of Locomotive Inspection, Interstate Commerce Commission

Mr. President, Members of the Railway Club of Pittsburgh, and Guests: It affords me much pleasure to be with you this evening and to greet you as co-workers in the maintenance of motive power on the railroads of the United States—the greatest system of railroad transportation that the world has ever known.

The Chairman of your Subject Committee very kindly suggested that I address you on the subject of "The Bureau of Locomotive Inspection and its Relation to Locomotive Maintenance." I have a vital interest in this subject, and I know of no way that he could have made me feel more at home than by inviting me to talk to you on the subject of my life's work. I say life's work because I have been employed by the Federal government in connection with the enforcement of the Locomotive Inspection Laws for nearly twenty-one years, and for even a longer time by the railroads in the operation and maintenance of locomotives.

The reason for the Locomotive Inspection Law is similar to that of all other laws. Laws are merely instruments through which governments gain the co-operation of the citizens for the purpose of attaining the greatest good for the greatest number. It is true that law represents compulsory co-operation, but compulsion need not be applied to law-abiding citizens. It is merely the occasional fellow who refuses to co-operate with his fellow-men to whom compulsion need be applied.

In the administration of any law or of any rules and regulations governing a body of men it should not be the purpose of the officer in charge to apply the penal provisions of such require-

ments to those who are willing to abide by them merely for the sake of displaying authority, but should, on the other hand, display leadership in obtaining full and complete co-operation on the part of those to whom the requirements apply. Genuine and whole-hearted co-operation on the part of all concerned is the foundation of success in any undertaking, and it has been the purpose of the Bureau of Locomotive Inspection to co-operate to the fullest reasonable extent with railroad officers and employees in obtaining the results intended when these laws were placed upon the statute books, and to expect and obtain reciprocal action from railroad officers and employees in bringing about improved methods and standards of locomotive maintenance. In this the Bureau of Locomotive Inspection and its relation to locomotive maintenance is indeed close.

The results obtained through the requirements of the Locomotive Inspection Laws during the years they have been in force have surpassed the fondest hopes of those who were instrumental in having them enacted by the Congress of the United States.

It affords me real pleasure and a great satisfaction to look back over the years that are gone and to see the changed attitude on the part of railroad officials toward the requirements. I often think of a letter written by the general manager of one of the most prominent railroad systems in the United States very soon after the law became effective in which he said "If the Boiler Inspection Act is enforced, it will bankrupt every railroad in the United States," to which the Chief Inspector at that time explained that the rules for inspection and maintenance of locomotive boilers adopted by the government were much less stringent by comparison than those previously in effect on his railroad, to which the general manager replied: "There is a wide difference between a rule which may be varied from at will and one which becomes law and must be complied with."

The variance at will from established rules and standards by those responsible for the inspection and maintenance of locomotives was the direct cause for the passage of these laws. In other words, the failure to maintain locomotives according to the railroad companies' own rules, which are now the government rules, is what brought about the passage of the Locomotive Inspection Laws.

The original Inspection Law, known as the Boiler Inspection Act, was passed by Congress and made effective in 1911. The purpose, as explained in the preamble is to: "Promote the safety

of employees and travelers upon railroads by compelling common carriers engaged in interstate commerce to equip their locomotives with safe and suitable boilers and appurtenances thereto."

The Boiler Inspection Act was amended in 1915 to include the entire steam locomotive and tender, thus making it the Locomotive Inspection Act. A later amendment brought within its purview all locomotives used on the line of any carrier subject to the Interstate Commerce Act without limitation as to ownership or kind of power by which they are propelled.

These statutes make it unlawful for any carrier to use or permit to be used on its line any locomotive unless said locomotive, its boiler, tender, and all parts and appurtenances thereof are in proper condition and safe to operate without unnecessary peril to life or limb, and unless said locomotive, its boiler, tender, and all parts and appurtenances thereof have been inspected from time to time and are able to withstand such test or tests as may be prescribed in the rules and regulations therein provided for. The statute takes cognizance of the fact that there exists a certain peril in locomotive operation which can not be foreseen nor entirely avoided, but when Congress used the phrase "proper condition and safe to operate without unnecessary peril to life or limb" it evidently intended, after due consideration, to place a responsibility upon every carrier coming within the purview of the law of keeping and making its locomotives as safe as humanly possible, and that all defects or improper conditions which might imperil safety that can be discovered by thorough and careful inspection be corrected before the locomotive is put in use.

The fact that this applies whether or not the rules and regulations established and approved by the Interstate Commerce Commission expressly prohibit the use of a locomotive while thus defective has been well established by the decisions of Federal courts. For instance, the court has said:

> "While the Interstate Commerce Commission is authorized to make rules and orders in furtherance of the enforcement of this law, the absence of rules covering defective construction or conditions within the meaning of Section 2 of the Boiler Inspection Act by no means relieves the carrier from complying with the provisions of that section."

It will be observed that the carriers' duties and responsibility are absolute and continuing and may not be evaded. The mere fact that a Federal inspector has not taken exception to any

method of inspection or repair does not relieve the carrier of the responsibility placed upon it.

The U. S. Supreme Court has said:

> "The fact that some particular feature of construction which has been found unsafe has not been disapproved by the Federal boiler inspector does not relieve the carrier from liability under Section 2."

Section 2 says that it shall be unlawful for any carrier to use or permit to be used on its line any locomotive unless said locomotive, its boiler, tender, and all parts and appurtenances thereof are in proper condition and safe to operate without unnecessary peril to life or limb.

The law further provides that there shall be appointed by the President by and with the advice and consent of the Senate a chief inspector and two assistant chief inspectors who shall have general superintendence of the inspectors therein provided for, direct them in the duties thereby imposed upon them, and see that the requirements of this Act and the rules, regulations and instructions made or given thereunder are observed by common carriers subject thereto.

It further provides that the said chief inspector and his assistants shall be selected with reference to their practical knowledge of the construction and repairing of locomotives and to their fitness and ability to systematize and carry into effect the provisions of the law.

RULES AND REGULATIONS

The requirements covering the construction, inspection and repair of locomotives and tenders under the law were derived from rules and regulations recommended and established by the best known authorities on mechanical matters, such as the mechanical division of the American Railway Association, the Locomotive Builders, and standard practices evolved by the railroads prior and subsequent to the enactment of the Locomotive Inspection Law.

The question naturally arises as to why it was necessary to enact a Federal law to enforce requirements that were already recognized as essential to proper up-keep of locomotives and to safety of operation. The answer to this question would take us back to the days when the art of "passing the buck" was enjoying its greatest popularity on the railroads. In other words, well recognized rules established by the carriers could be varied

from by those in direct charge of inspection and maintenance at will—or to suit what seemed to be the occasion.

In those days the motive power department was generally looked upon by other departments of the railroad as a necessary and expensive evil rather than one of the most essential departments in the successful movement of transportation and railroad operation. I say this with due respect to the transportation and all other departments connected with the operation of a railroad. The mechanical organization is the one that must be depended upon for proper design, construction and maintenance of motive power, without which no railroad can successfully operate. It is the well designed, constructed, maintained and equipped locomotive that brings the greatest monetary return.

An engine failure in former years meant an opportunity to censure the mechanical department, and this was frequently passed on to an engineman or shopman.

Many of those who held the purse strings were short-sighted to the extent that they did not see where vast operating economy and reduction of accidents would result from the use of well maintained, well equipped and efficient locomotives; did not understand that after the motive power was once put in good condition that it could be maintained in that condition at less expense than when following the haphazard maintenance policy the motive power departments were then obliged to follow.

Finally, the question of unnecessary loss of life or limb because of failures of defective locomotives came to the forefront, and after it was demonstrated that the railroads as a whole were unable or unwilling to enforce their own standards of safety Congress was asked to consider the question. The result was the enactment of the Boiler Inspection Act, which by reason of subsequent amendments hereinbefore referred to became the present Locomotive Inspection Act.

PREVENTION

It may be noted that Congress had in mind prevention of unnecessary loss of life or limb by prohibiting carriers from operating defective and unsafe locomotives, and holding the carriers responsible for general design, construction and maintenance of locomotives—in other words, by requiring preventive maintenance.

The Bureau of Locomotive Inspection is the agency through which the mandate of Congress is enforced. Therefore, our work is closely allied with that of the railroad officers and employees

and that of railway equipment manufacturers who supply the modern equipment and who have done so much, in co-operation with the railroads, to make the modern locomotive the most efficient machine of its kind today.

INSPECTION

Inspection is emphasized because it is the basis of proper maintenance. No one may know the condition of a complicated machine until after it has been thoroughly inspected and tested. Experience has taught that the only safe policy is the full recognition of the fact that a potential accident lurks in the shadow of apparently insignificant defects. With this in mind, Rule 104 of the Rules and Instructions for Inspection and Testing of Steam Locomotives and Tenders, and Rule 203 of the Rules and Instructions for Inspection and Testing of Locomotives Other Than Steam, which are identical in wording and intent, require:

> "Each locomotive and tender shall be inspected after each trip, or day's work, and the defects found reported on an approved form to the proper representative of the company. This form shall show the name of the railroad, the initials and number of the locomotive, the place, date and time of inspection, the defects found, and the signature of the employee making the inspection. The report shall be approved by the foreman, with proper written explanation made thereon for defects reported which were not repaired before the locomotive is returned to service. The report shall then be filed in the office of the railroad company at the place where the inspection is made."

This trip or daily inspection, and report thereof, enables those in charge of repairs to keep informed of the current condition of each locomotive, and furnishes the means whereby the quality of inspections and sufficiency of repairs can be determined. The value of the inspection reports in the elimination or reduction of defects, of course, depends upon the thoroughness of the inspections made, the integrity and clarity of the reports, and the amount of interest displayed by foremen and others having jurisdiction over repairs. It is not the purpose of the rule to permit locomotives to be returned to service with any defects in violation of the Act, or any rule, regulation or instruction made or given thereunder. It is, therefore, essential that the officer charged with the duty of passing upon inspection reports and necessary repairs have thorough knowledge of the requirements

and be endowed with sound judgment in order that all repairs may be made in proper time and place. It might seem unnecessary to say that the decision as to what repairs shall be made should not be based on expediency, but unfortunately too often we find that proper inspections and proper repairs are deferred because of what seems to be to those in direct charge a pressing necessity, in other words, to vary from the requirements at will or take another chance. A locomotive should not be permitted to leave a terminal with any defect or condition that is at all likely to cause failure while en route.

Many officials do not take full advantage of the opportunity afforded by the daily inspection reports to keep informed of the durability of repairs made from trip to trip. It is too often found that the same defects are repeatedly reported, with evidence that repairs have been attempted each time the defects were reported. Repetition of reports should be ample warning that the methods of repair are not effective, that progress is not being made, and that time and money are being wasted. Comparisons of the items reported on individual locomotives from trip to trip will point out ineffective repair methods, pay big dividends in the reduction of defects, greater security, and reduced cost of maintenance. If a defect is repeatedly reported, it is evidence that there is something wrong; therefore, the cause should be sought and a permanent remedy applied. It should at all times be borne in mind that the degree of thoroughness with which repairs are made may mean the difference between success or failure in the matter of keeping locomotives in proper and safe condition.

The carriers enjoying the greatest success in maintaining locomotives in a high state of repair are those having a systematic outbound as well as a systematic inbound inspection: The outbound inspection need not be as elaborate as the inbound inspection, but it should consist of inspection of all parts to which repairs have been made in seeing that they have been properly made, a general looking over of the locomotive including interior of the firebox, and test of injectors, feed-water pumps, water level indicating appliances, brake and signal equipment, lighting equipment, train control equipment, etc. The engineer should be furnished with a machine ready to perform all of the exacting duties expected of it if the best and safest results are to be accomplished.

Monthly and annual inspections and repairs are also required. The monthly inspection consists of general thorough inspection of

all accessible parts of the locomotive including running gear, driving gear, boiler, and tender; testing of stay bolts; washing boilers; cleaning water glass cocks and gauge cocks; testing steam gauges and setting safety valves when due; removal of drawbar between locomotive and tender and inspection of drawbar and pins when due; inspection for steam leaks; testing of all appurtenances; and repairs of all defects found. The annual inspection includes the foregoing, together with hydrostatic test of the boiler and interior inspection; testing of flexible stay bolts due; and if due removal of flues and removal of jacket and lagging for interior and exterior inspection of boiler.

BACK SHOP INSPECTIONS AND REPAIRS

I have spoken about running inspections and repairs and tests first because that is the big job—a job that requires continuous vigilance and never ceasing effort. There are, however, other major factors that have a controlling influence in maintaining locomotives in proper condition. The design, the material, the character of original construction, and the back shop repairs influence the ease with which locomotives may be maintained. Assuming that the builders and associated agencies have fully performed their duties, high quality repairs must be made in the back shop if defects in service are to be minimized.

Here again inspection plays a major part. It is a recognized principle of all successful production methods that thorough inspection of each component part, and of the assembled unit, is essential in the control of quality. When locomotives are shopped for general repairs, all parts should be thoroughly cleaned and inspected. All repairs needed to restore wear and place all parts in good condition should be properly applied in order that the locomotive may re-enter service in such condition that major renewals will not be needed during its expected term of service between shoppings. This statement holds true even if the locomotive may not be of the most modern type. So long as a locomotive is to be continued in use, it should be turned out after each general repair with unimpaired original capacity.

Inspection again has its part after repairs are completed because too often we find that the back shop is more interested in quantity production than it is in turning locomotives out that will perform a full term of service without undue attention in the interim. Obviously, it is a difficult and costly undertaking for the running repair forces to attempt to maintain a locomotive in

proper condition if turned out of the back shop with numerous defects existing, or in imminent process of development.

CO-OPERATION OF OPERATING OFFICIALS

Proper conditioning of locomotives to perform the exacting service required by modern operating methods can not be accomplished without co-ordination and co-operation of those in authority in the operating and mechanical departments. If may appear to some that the task of maintaining locomotives in good condition falls wholly on the mechanical department, but whether or not we would have it so the fact remains that the attitude of the operating officers, because of the authority exercised over the use of locomotives, and in other directions, has a large influence on what can be accomplished by the mechanical department; therefore, the best results can be obtained only by full co-operation on the part of both.

While this is the age of accomplishment through the use of machinery, in the final analysis success depends upon dealing with men rather than with machines. In other words, we may say that this is the age in which we have come to realize that success depends upon mutual understanding, co-ordination, and co-operation.

RESULTS ACCOMPLISHED

As a result of complying with what are now legal requirements, it is generally recognized that high standards of maintenance and safety are more economical and efficient than low standards with their consequent risk of accident and disruption of traffic. Improved standards of construction and maintenance have not only been instrumental in bringing about the greatest degree of safety of locomotive operation ever recorded, but have contributed in full measure to the present day dependability of passenger and freight train movement, increased speed, and economy in consumption of locomotive fuel. This is illustrated by a tabulation which I have had prepared which shows the percentage of locomotives inspected found defective; number ordered out of service by Federal inspectors; number of accidents resulting from the failure of some part or appurtenance of the locomotive; number of persons killed; and number of persons injured, derived from the annual reports of the Bureau of Locomotive Inspection; and average miles per hour of trains in freight service, pounds of coal per 1000 gross ton miles including locomotive and tender, and pounds of coal per passenger train car mile, derived from the re-

ports from the Bureau of Statistics of the Interstate Commerce Commission, and calculated to the fiscal year basis for the years ended June 30, 1923, to and including the fiscal year ended June 30, 1931.

AVERAGE RESULTS ACCOMPLISHED COVERING THE ENTIRE COUNTRY, FROM RECORDS OF THE INTERSTATE COMMERCE COMMISSION

Fiscal year ended June 30	Per cent of locomotives inspected found defective	Number of locomotives ordered out of service	Number of accidents	Number of persons killed	Number of persons injured	Average miles per hour trains in freight service	Pounds of coal per 1000 gross ton miles including locomotive and tender	Pounds of coal per passenger train car mile
1923	65	7075	1348	72	1560	10.6	167	18.5
1924	53	5764	1005	66	1157	11.3	154	17.3
1925	46	3637	690	20	764	11.7	143	16.4
1926	40	3281	574	22	660	11.9	139	16.0
1927	31	2539	488	28	517	12.0	133	15.6
1928	24	1725	419	30	463	12.6	129	15.2
1929	21	1490	356	19	390	13.0	126	14.9
1930	16	1200	295	13	320	13.4	123	13.9
1931	10	688	230	16	269	14.3	119	13.6

It will be noted from the table that from 1923 to 1931, both inclusive, the percentage of locomotives inspected found defective decreased from 65 to 10; the number of locomotives ordered out of service decreased from 7,075 to 688, or 90.3 per cent; the number of accidents decreased from 1,348 to 230, or 82.9 per cent; the number of persons killed decreased from 72 to 16, or 77.8 per cent; the number of persons injured decreased from 1,560 to 269, or 82.8 per cent; the average miles per hour of trains in freight service increased from 10.6 to 14.3, or 34.9 per cent; the number of pounds of coal consumed per thousand gross ton miles decreased from 167 to 119, or 28.7 per cent; and the number of pounds of coal consumed per passenger train car mile decreased from 18.5 to 13.6, or 26.5 per cent.

I have prepared a chart which illustrates the tendencies indicated by the foregoing statistics. It will be noted that the lines "Casualties" and "Accidents" closely parallel the line showing percentage of Defective Locomotives. Where this percentage increases the number of Accidents and the number of Casualties show corresponding increases and where the percentage of Defective Locomotives decreases the number of Accidents and number of Casualties show corresponding decreases. The steady decline in all three items is very noticeable since 1923.

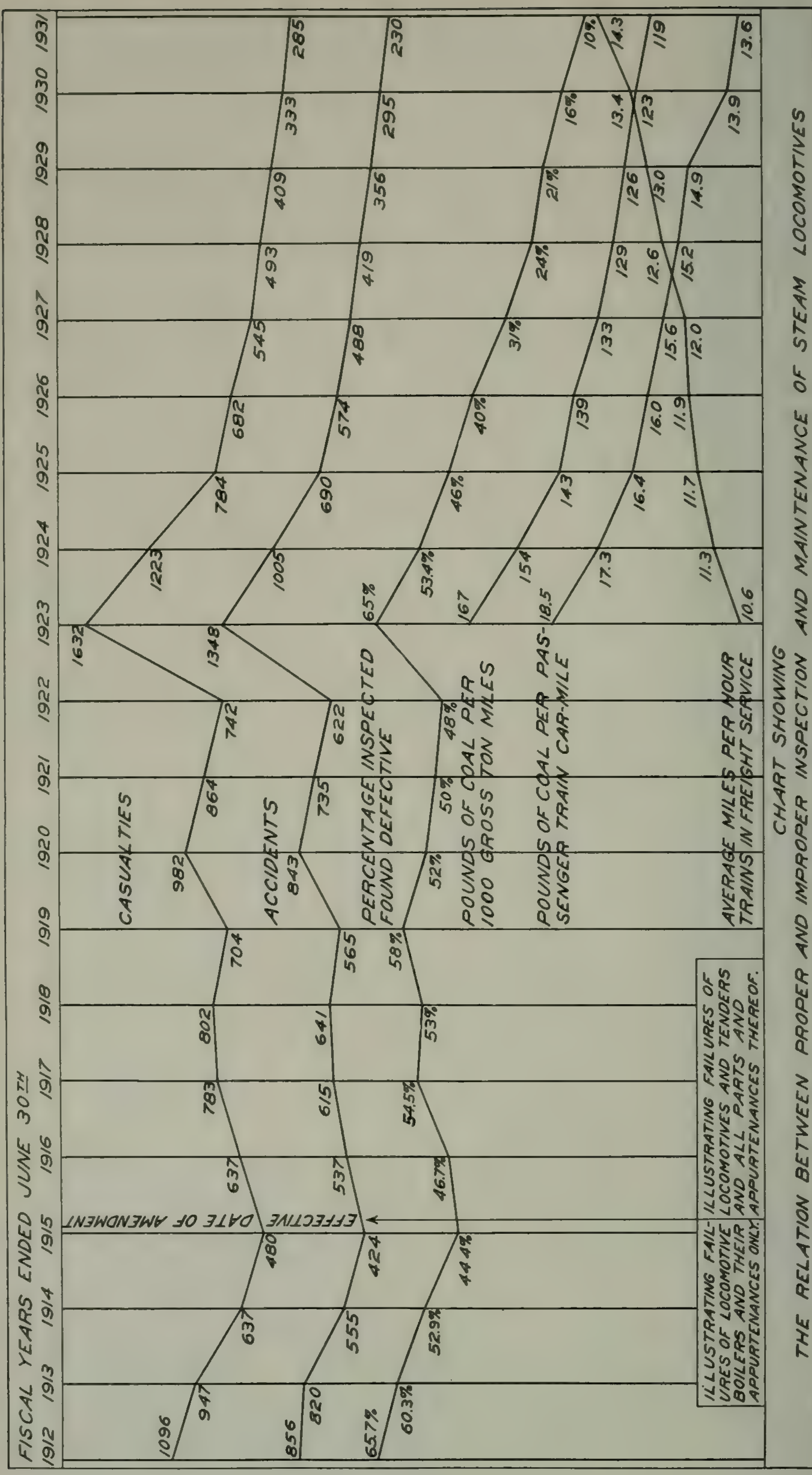

CHART SHOWING
THE RELATION BETWEEN PROPER AND IMPROPER INSPECTION AND MAINTENANCE OF STEAM LOCOMOTIVES

The shorter lines at the bottom of the chart are from top to bottom on the vertical line 1923; pounds of coal per thousand gross ton miles, pounds of coal per passenger train car mile, and average miles per hour of trains in freight service. It will be noted that coincident with the improvement in condition of locomotives represented by the line "Defective Locomotives" there has been a corresponding reduction in the pounds of coal consumed per thousand gross ton miles and pounds of coal consumed per passenger train car mile, and an increase in average speed of freight trains from 10.6 miles per hour in 1923 to 14.3 miles per hour in 1931.

There are fewer locomotive accidents today than at any time since authentic records have been maintained with a marked decrease in the number of boiler explosions and fire box failures as a result of low water and other causes. For instance, during 1912 there were 94 accidents of this character as compared with 14 during 1931, a reduction of 85 per cent; 54 persons were killed in this class of accidents in 1912 as compared with 15 in 1931, or a reduction of 72 per cent; 168 persons were injured in 1912 as compared with 41 in 1931, or a reduction of 76 per cent.

The well designed, the well constructed, the well equipped, and the well maintained locomotive has unquestionably contributed its full share in the reduction of accidents and casualties and fuel consumption, as well as increased freight train speed, to which I have previously referred; and I may say without fear of contradiction that the mechanical organizations on the American railroads, in co-operation with the operating organizations and other departments, have played their full part in bringing about these improvements.

Locomotives in use today, with rare exception, are being maintained in the best condition of which there is any record, which is in the interest of greater safety to the public and the employees, as well as efficiency and economy of operation. Railroad people throughout the country, from my point of view, are vying with one another in an effort to improve their service in every particular to the great American public in a way probably never before exceeded; notwithstanding the terrible depression through which we have been passing for more than two years, from which everyone has been suffering, and especially the wage and salary earners who could not lay by something for the stormy day.

The improvements to which I have heretofore referred are extremely gratifying to me, and I know they must be to you and

to every other person directly or indirectly concerned with the successful operation of our railroads.

Mr. President, Members of the Pittsburgh Railway Club, and Guests, I appreciate more than I can find words to express the cordial greetings which you have extended to me here this evening, and this same appreciation goes out to and includes the railroad officers and employees throughout the country and the railway supply manufacturers for the cordial co-operation I have received at their hands in carrying out the requirements of the Law. I thank you.

PRESIDENT: Gentlemen, you have heard a very informative address and from the splendid attendance this evening it is not going to be very hard to stir up such an interest as will give us a good discussion. Mr. Pack will be glad to answer any questions you may wish to ask. I hope it will not be necessary for me to call on you to start the discussion. In looking over this crowd I see a great many mechanical men here. The meeting is yours for discussion.

MR. HENRY F. GILG: After hearing Mr. Pack's paper you can see what has been accomplished by the Bureau of Locomotive Inspection, and the railroads should be very grateful to him for it. I have believed for a good many years that there is one point on which I know an improvement has been made, and that is in the matter of staybolts. The boiler presents a dangerous situation always.

PRESIDENT: We have with us Mr. A. P. Prendergast, Superintendent of Motive Power of the Texas Pacific. We are glad to have him here, coming from so long a distance to visit this Club. Mr. Prendergast will you say something in connection with this subject?

MR. A. P. PRENDERGAST: Mr. President and Gentlemen: I am sincerely glad to be among you. I spent a number of years here and I see many familiar faces, and I appreciate very much the pleasure of being again with you and sharing in the valuable and practical records and information that we have all heard tonight from the Chief Inspector, Mr. Pack. I could not do more than to take up your time with corroboration of all that he has set forth. It would be easy to amplify the statements that have been made as to the benefits and blessings of the wonderful work he has done and is constantly expanding for the

benefit of humanity, our employees, the traveling public, and the safe and successful operation of the railroads. I thank you.

PRESIDENT: Mr. A. R. Kennedy, of the Monessen S. W. Ry.

MR. A. R. KENNEDY: Mr. President, I feel somewhat ashamed of myself that I have been a member of this Club for a long time and have failed to attend many of your meetings. The railroad I represent is a small one and I am not versed in the qualities of staybolts and that sort of thing. I know we use the best we can get and we have very few accidents.

PRESIDENT: Colonel Nutt, Vice-president of the Monongahela Railway Co., have you anything to add?

COL. H. C. NUTT: I have been tremendously interested in the address of Mr. Pack and I think we all should pay him a tribute of respect and congratulation for making us do what we ought to have done for ourselves but would not do and did not do until he pushed us. The results he accomplished are shown in the charts and they thoroughly justify what we all at first thought, an interference with our part of the job. But we did not attend to it until Mr. Pack got on the job and forced us to do it. I thank him and I think all of us should thank him for the work he has done in the last 21 years.

PRESIDENT: Mr. J. R. Geddes, Vice-president and General Superintendent, Monongahela Connecting Railroad, may we hear from you?

MR. J. R. GEDDES: Mr. President, I think we have heard a very wonderful paper. I haven't anything to add to it.

PRESIDENT: Mr. S. G. Down, Vice-president, Westinghouse Air Brake Co., we are very glad to have you here tonight. Have you anything to say to us?

MR. S. G. DOWN: Yes, I am pleased to say something but, not having locomotives to maintain, I am not familiar with the modern practice of maintaining staybolts and boiler sheets. However, we all know that Mr. Pack and his organization have rendered a very important service to the railroads. A point that stood out in my mind in Mr. Pack's paper was the statement of the remark made by a General Manager of a railroad to the effect that railroads would go bankrupt if they followed the rules

laid down by the Bureau of Inspection and Mr. Pack's statement to the effect that such rules were really no different than those already established by the railroad. This General Manager thought his particular road was living up to their own rules whereas, as a matter of fact, it was not. How difficult it is for us to see ourselves as others see us and how unfortunate that we are compelled by law to make ourselves behave. I was very glad, indeed, to see the record Mr. Pack showed of the wonderful efficiency now obtained and reduction in the number of accidents and loss of life and Mr. Pack and his organization and also the railroads are to be congratulated on the results all are now enjoying.

PRESIDENT: Uncle Tom Cannon, General Superintendent Locomotives and Equipment, P. & W. Va., we would like to hear from you.

MR. THOMAS E. CANNON: Mr. President and Everybody, I wish you would get your information from an older man than I am and one that has had more experience.

PRESIDENT: Mr. J. J. Maginn, Superintendent of Motive Power of the Nickel Plate. We are glad to have you with us, may we hear from you?

MR. J. J. MAGINN: I am a stranger in this room. You are to be congratulated on having Mr. Pack with you tonight, and he is to be congratulated on the paper he has just read. I have heard many of these discussions before and there is no question that I would want to ask Mr. Pack. He has given us a lot of information about the railroad business. I thank you.

PRESIDENT: Anybody else?

MR. HERBERT LEWIS (Former U. S. Government Inspector of Locomotives): Mr. Chairman, I have listened with profound interest to my former Chief's very excellent paper, also to Mr. Flannery's introductory remarks wherein he stated that Mr. Pack was a kind and lovable man. This, I know to be true, having served as a Federal Inspector of Locomotives in Western Pennsylvania directly under Mr. Pack for eight or nine years.

There are some incidents connected with the history of the Locomotive Inspection Bureau that are not on the records and, while I may be telling tales out of school, I am going to relate an amusing incident that took place in Mr. Pack's offices in Washington.

During the period following the dark days of the war, a conference was called to discuss and formulate certain changes in the book of rules governing the field work.

The several Inspectors present were quite in agreement regarding a certain subject under discussion, but Mr. Pack did not see his way clear to concur. He was evidently from Missouri and, as usual, had to be shown. Just to show what is sometimes necessary to secure results, the several Inspectors present had to take their Chief by the heels, lower him head down, out of the sixth story window of the Interstate Commerce Building in Washington and hold him there until he would agree with the rest of them. It is needless to say that an agreement was very shortly reached.

During the years I served the Government, the personal contact I enjoyed with Mr. Pack, as Assistant Chief and, subsequently, Chief of the Department, has resulted in the same feeling as was expressed by Mr. Flannery, "Mr. Pack is a kind and courteous gentleman, always considerate of an opposing opinion."

If we sometimes differed in opinion, we could agree to disagree and, at the same time, labor in harmony for the welfare of the great work of the department. Those years I served in close contact with Mr. Pack will always remain a fond recollection as a worthwhile experience.

The thought that Mr. Flannery expressed at the conclusion of his introductory remarks is true. If it should so happen that Mr. Pack should be promoted to a higher position and another should take his place, the men that have worked with him for years will certainly miss the contact of his kind and lovable personality. I thank you.

PRESIDENT: We have with us tonight Mr. F. G. Grimshaw, Works Manager, P. R. R. at Altoona. We would like to hear from him.

MR. F. G. GRIMSHAW: Mr. President, I know we used to think that the Federal inspectors were pretty tough. But we found later that they were fine fellows and always ready to help us. Mr. Pack referred to the fact that first class maintenance and low cost go hand in hand. That has been exactly our experience. I thank you.

PRESIDENT: Mr. B. E. Jones, Master Mechanic, Erie Railroad, Hornell, N. Y.

MR. B. E. JONES: I am glad of the opportunity to be here tonight. I made a special effort to get here and to carry back the message of the speaker of the evening to the employees under my jurisdiction. I thank you.

PRESIDENT: Mr. Karl Berg, Superintendent of Motive Power, P. & L. E. R. R.

MR. KARL BERG: I also wish to add a word of appreciation on behalf of the Pittsburgh & Lake Erie Railroad, and particularly on the part of the Locomotive Department to Mr. Pack, also to his associates, for the co-operation they have given the Pittsburgh & Lake Erie Railroad. We have not always been correct—some mistakes have been made, and criticism received from time to time, but it has been of the most constructive and friendly kind.

I have been connected with the Mechanical Department of the P. & L. E. since the time the activities of the Bureau started. I can look back on some of the things that were done during the first period, and I remember some of the practices that particularly concerned the building of locomotive boilers at that time, also some of the formulae then in use, and can see how gradually by co-ordinating and studying all these practices and formulae, improvements were made until today we have arrived at uniformity all over the country, resulting in the construction of the locomotive boilers used today.

Being a locomotive member of this Club, so to speak, I also appreciate very much Mr. Pack's coming here and telling us of some of the things that have to be done from the time an engine is relieved from service until it is again offered for service. A little explanation of that kind is not amiss, and possibly we should have more of it. It is important and it is enlightening, as a great deal of serious work and consideration have to be put forth in order to produce the kind of locomotive that is required today; also to meet the requirements of the locomotive inspection law. Thank you.

PRESIDENT: Mr. G. S. West, Superintendent, Pennsylvania Railroad. We would like to hear a word from you.

MR. G. S. WEST: I have listened with a great deal of interest to Mr. Pack's remarks. I was very much interested in the chart he presented to us, and I recall distinctly back in 1923 in the days when we were about as glad to see the inspector as

the smallpox and we all stood around and wondered whether we would get a hand full of pink tickets. It is interesting to see today the co-operation between the inspectors and the mechanical department, and how it has brought about wonderful results in working to an intelligent program, to produce locomotives that would haul the greatest tonnage. And Mr. Pack and his inspection department have been largely responsible and very helpful in accomplishing these results.

PRESIDENT: Mr. R. M. Long, Air Brake Inspector, P. & L. E. Railroad, has had a lot of experience in locomotive work.

MR. R. M. LONG: I would not have missed this meeting. But in very great part you have confined the remarks to boilers, with which the air brake man has nothing to do, and therefore he does not have anything to talk about.

COLONEL NUTT: Before we adjourn I would move that in appreciation of the very interesting paper that Mr. Pack has delivered to us we extend to him a rising vote of thanks.

The motion was duly seconded and prevailed by unanimous vote.

MR. PACK: Mr. President and Members of the railway fraternity, I must say that I think you have overestimated my value. I want to say that you people are the people who have brought about this improvement. I may have had to take the lead sometimes, but without your co-operation and help little would have been accomplished, and the credit belongs to you.

PRESIDENT: If there is nothing further, we will stand adjourned.

J. D. CONWAY, Secretary.

In Memoriam

F. A. OGDEN

Died February 1, 1932

RESERVED

OFFICIAL PROCEEDINGS
RAILWAY CLUB OF PITTSBURGH
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Vol. XXXI. MARCH 24, 1932. No. 5.

THE PRESENT RAILWAY SITUATION

By SAMUEL O. DUNN, Chairman of Board, Simmons-Boardman Publishing Company, and Editor, Railway Age, Chicago, Ill.

OFFICIAL PROCEEDINGS

OF

The Railway Club of Pittsburgh

Organized October 18, 1901

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Organized October 18, 1901

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Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING
MARCH 24, 1932

The meeting was called to order at the Fort Pitt Hotel at eight o'clock, P. M., with President J. E. Hughes in the chair.

The following gentlemen registered:

MEMBERS

Ainsworth, J. H.
Allen, Harvey
Altsman, W. H.
Anderson, Burt T.
Ashley, F. B.
Babcock, F. M.
Baer, Harry L.
Bald, E. J.
Barr, H. C.
Beam, E. J.
Beeson, H. L.
Berg, Karl
Blair, John R.
Bowen, James T.
Bradley, W. C.
Brinkhoff, W. H.
Buffington, W. P.
Burnette, G. H.
Campbell, J. E.
Cannon, T. E.
Chilcoat, H. E.
Clements, F. C.
Conway, J. D.
Coombs, A. B.
Cotter, G. L.
Coulter, A. F.
Courtney, H.
Cox, W. E.
Crawford, A. B.
Crawford, D. F.
Crenner, Joseph
Cunningham, J. D.
Cunningham, R. I.
Dalzell, W. E.
Dambach, C. O.
Davis, Charles S.
Davis, James
Deasy, J. F.
Dempsey, P. W.
Dennis, J. G.
Diven, J. B.
Downes, D. F.
Eagan, D. F.
Emery, E.
En Dean, J. F.
Endsley, Prof. Louis E.
Farrington, R. J.
Ferrick, J. T.
Fisher, John J.
Flinn, R. H.
Follett, W. F.
Forsberg, R. P.
Fults, J. H.
Furch, George J.
Gardner, George R.
Geddes, James R.
Gilg, Henry F.
Glaser, J. P.
Goda, P. H.
Goff, J. P.
Hamilton, W. H.
Hansen, William C.
Hastings, W. S.
Herbert, T. C.
Herrold, A. E.
Hervey, R. S.
Hill, W. D.
Hilstrom, A. V.
Holmes, E. H.
Hoover, Jacob W.
Hosford, C. C.
Huber, H. G.
Hughes, John E.
Hykes, W. H.
Kellenberger, K. E.
Keller, R. E.
Kelly, J. P.
Kennedy, F. J.
Kirk, W. B.
Kraus, Raymond E.

Krause, H. A.
Kromer, William F.
Kulp, J. G.
Kummer, Joseph H.
Lanahan, Frank J.
Lanahan, J. S.
Laughner, C. L.
Lee, L. A.
Leet, C. S.
Lehr, H. W.
Leiper, C. I.
Loeffler, George O.
Longdon, Clyde V.
Lunden, C. J.
Marquis, George E.
Mason, S. O.
Mayer, L. I.
Mertz, G. H.
Miller, J. F.
Miller, R. C.
Miller, W. H.
Mills, C. C.
Misner, George
Mitchell, Frank K.
Mitchell, W. S.
Morgan, A. L.
Morgan, Homer C.
Myers, Arnold
Myers, R. C.
McCauley, William
McCloskey, J. C.
McIntyre, R. C.
McKinley, John T.
McKinstry, C. H.
McKinzie, E.
McMillan, A. P.
McMullen, C. E.
Nagel, James
Nannah, F. J.
Nash, R. L.
Nieman, Harry L.
Noble, J. A.
Nutt, Col. H. C.
Orchard, Charles
O'Toole, J. L.
Paisley, F. R.
Palmer, E. A.
Paul, Lesley C.
Pringle, Paul V.
Rankin, B. B.
Rauschart, E. A.
Renshaw, W. B.
Richardson, H. R.
Rieker, H. M.
Rowles, H. N.
Rudd, W. B.
Rushneck, G. L.
Sattley, E. C.
Sauer, G. L.
Schmidt, E. M.
Schmitt, Raymond F.
Schoch, M. G.
Schrader, A. P.
Schrecongost, C. P.
Schultz, Charles H.
Seiss, W. C.
Sekera, Charles J.
Severn, A. B.
Schaffer, W. E.
Shafer, John S.
Shannon, W. R.
Sharp, H. W.
Sheets, H. E.
Shield, Arthur
Sinclair, I. B.
Sixsmith, G. M.
Smith, H. K.
Smith, J. Frank
Smith, Robert B.
Snyder, F. I.
Snyder, J. J.
Stamm, Bruce B.
Sterling, C. C.
Stevens, R. R.
Storer, N. W.
Stucki, A.
Sutherland, Lloyd
Thomas, H. N.
Thomas, T. T.
Thornton, A. W.
Tipton, George M.
Trax, Louis R.
Tucker, J. W.
Van Blarcom, W. C.
Van Wormer, G. M.
Venning, J. C.
Warfel, J. A.
Warner, R. H.
Waterman, E. H.
Weiler, Paul
West, G. S.
Wheeler, C. M.

Wiggins, W. D.
Wildin, G. W.
Wilharm, J. H.
Winslow, S. H.
Woodward, R.
Wright, Edward W.
Wright, John B.
Wyke, John W.
Wynne, F. E.
Yarnall, Jesse

VISITORS

Bailey, J. H.
Berry, H.
Bowman, John H.
Bowler, R. W. E.
Bricker, O. F.
Buck, L. L.
Carson, C. E.
Cunningham, H. B.
Curcio, Harry
Curcio, Milo
Duff, Ralph G.
Duff, S. B.
Farney, H. N.
Farrington, A. R.
Farrington, R.
Fike, J. W.
Flatley, Wm. J.
Friend, E. F.
Frobe, Joseph
George, R. H.
German, H. J.
Germerodt, H. Edward
Girty, E. C.
Gollmer, H. C.
Gray, A. H.
Guidotti, Bettie Lee
Guidotti, Harry
Haas, Walter E.
Harper, Kenneth
Heer, W.
Henry, S. R.
Herley, J. E.
Hill, E. T.
Hill, R. W.
Holmok, S. M.
Irwin, J. J.
Jacobs, M. H.
Jedinak, Joseph M.
Jenness, D. H.
Jennings, A. S.
John, William
Kemp, Charles M.
Krick, F. H.
Kromer, Walter W.
Lais, G. J.
Leaf, C. Stuart
Lewis, S. B.
Loughridge, H. W.
Macdonald, George A.
Meily, R. P.
Mitchell, Paul S.
Montague, C. F.
Moore, David M.
Moore, E. W.
Moore, J. W.
McCormick, E. S.
McCune, John
McGregor, S. S.
McIntire, R. H.
Nicholson, F. H.
Oldham, Ronald
Reithel, B. H.
Reynolds, A. C.
Roberts, R. E.
Rodkey, H. E.
Rose, A. J.
Sargent, L. L.
Schaller, A. J.
Scheffer, A. A.
Schott, F. J.
Seiler, H. C.
Scott, W. A.
Smith, Sion B.
Snyder, H.
Sperry, H. M.
Stamm, J. Duncan
Suess, Edward
Triem, W. R.
Tripp, W. C.
Tripp, W. N.
Tyson, Thomas
Van Wert, C. W.
Vollmer, W. K.
Walton, H. A.
Weltz, E. E.
Wheatley, Albert R.

Wibner, A. J.	Wirth, J. E.
Wilson, W. S.	Woods, G. M.

Woods, W. E.

The meeting was preceded by an interesting entertainment program led by Mr. Harry Guidotti, Magician, his daughter Bettie Lee in a song and dance part and Joseph Frobe, Edward Suess and J. E. Wirth presenting instrumental Hawaiian music and songs.

PRESIDENT: The registration cards give a full record of attendance, so we will dispense with the calling of the roll.

The minutes of the last meeting are in print and have been distributed to you, so we will also dispense with the reading of the minutes of the last meeting.

We will now have the list of proposals for membership.

SECRETARY: We have the following proposals for membership:

Beck, John G., Representative, Travelers Insurance Company, 1649 Shady Avenue, Pittsburgh, Pa. Recommended by Karl Berg.

Connors, John M., Assistant Foreman Car Department, Montour Railroad, 208 Sebring Avenue, Beechview, Pittsburgh, Pa. Recommended by E. A. Rauschart.

Gillespie, J. Porter, Assistant General Superintendent, Lockhart Iron & Steel Company, P. O. Box 1243, Pittsburgh, Pa. Recommended by A. B. Severn.

Hepburn, P. W., Lubricating Engineer, Gulf Refining Company, 6963 Frankstown Avenue, Pittsburgh, Pa. Recommended by E. A. Rauschart.

Montague, C. F., Supervisor, Pennsylvania Railroad, Homestead, Pa. Recommended by H. G. Huber.

Schaller, Andrew J., Assistant Supervisor, Pennsylvania Railroad, 3626 Main Street, Homestead, Pa. Recommended by H. G. Huber.

PRESIDENT: In accordance with our By-laws these proposals will be referred to the Executive Committee, and upon approval by them the gentlemen will become members without further action of the Club.

SECRETARY: Since our last meeting we have received information of the death of Mr. W. J. Wilson, "Retired" Engineer, P. & L. E. R. R. Co., which occurred on March 8, 1932. Mr. Wilson became a member of the Club on October 28, 1904.

PRESIDENT: An appropriate memorial minute will appear in the next issue of the Proceedings.

If there is no further business to be taken up at this time, we come to the paper of the evening. We are glad to have with us tonight a gentleman who honored us by addressing us some years ago. We are honored again by his presence. It gives me great pleasure to introduce to you Mr. Samuel O. Dunn, Editor of the Railway Age, Chicago, Ill., who will address you on "The Present Railway Situation."

THE PRESENT RAILWAY SITUATION

By SAMUEL O. DUNN, Chairman of Board, Simmons-Boardman Publishing Company, and Editor, Railway Age, Chicago, Ill.

Mr. President and Fellow Members of the Railway Club of Pittsburgh: I like to use that expression, Fellow Members, because perhaps many of you do not know that I am a member of this Club. It is a great pleasure to be here again and to be greeted by so many friends. I appreciate more than I can tell you this large attendance, because so many of you have heard me discuss similar subjects before.

Your President has just mentioned the fact that I have addressed this Club before. Mr. Conway earlier in the evening reminded me that it was in March, 1923, a very significant thing, it seems to me, because that was the month that immediately preceded the meeting of the railway executives in New York at which they adopted a program to furnish the country with adequate and efficient transportation. And not only because of what occurred in earlier years, but also what has occurred within the past year, I should say they were very successful. The one thing that is lacking now is adequate traffic.

A great deal of water has gone over the dam during the period since the early part of 1923. If you will recall the conditions then you will remember that in the latter part of 1922 the railroads had gone through a great shop crafts strike and during the latter part of 1922 and the early part of 1923 they had to contend with the largest car shortage in history. The

problem then of furnishing adequate and efficient transportation was completely solved by large capital expenditures and a great increase in efficiency of operation, and during the subsequent period of prosperity, beginning in 1923 and lasting until the latter part of 1929, the country was furnished the best and the most rapidly improving service it has ever known. I need not tell you that more recently we have been going through a period of depression during which the decline of traffic has been the greatest ever known. In what I am going to say I am going to review that period and perhaps include a good many statistics which are necessary to make clear the points that I am driving at.

But I would like to say, because otherwise this paper that I am going to present might sound pessimistic, that I often have the good—or bad—fortune to be out of step with many people. In 1929 I considered the business situation in this country most dangerous and repeatedly made pessimistic predictions. For three years I repeatedly said there was absolutely no justification for the prices being paid for railroad securities. Now, after thirty months of this depression, although the conditions are the worst that they have ever been, I am again out of step with most people, because I am perfectly certain that fundamental tendencies are sound and that we are on the way out.

The most encouraging and inspiring development that has occurred in this country in many years is the development of a public demand, which is now almost universal, for far-reaching reforms in our governments, local, state and national.

Just when many had begun to believe that democracy was a failure, the American democracy is rising in its might to compell changes in government which are essential to the restoration of law and order, and the reestablishment of prosperity. Our governments had almost abdicated their primary function of suppressing and preventing crimes and maintaining equality of opportunity for all citizens largely because they were devoting themselves principally to socialistic measures for "soaking the rich", interfering with business, engaging in competition with business, lavishly subsidizing politically-influential industries and classes and providing jobs for tax-eaters, all ostensibly "in the public interest", when almost suddenly there burst upon them the present storm of public indignation because of the enormous and economically intolerable increases in taxes in which these stupid and reckless policies were resulting.

Almost every democracy which has failed in the past has been destroyed principally by just such policies. All over the world today civilized nations are being threatened with economic destruction by such policies. Never in history did any nation travel more rapidly the road toward ruin, because of efforts to tax itself rich, than has the United States within the last decade. The enormous increases in government expenditures which have occurred, and which have not yet been stopped, were one of the principal causes of the present depression, and unquestionably have been the principal cause of its deepening and prolongation. The politicians in Washington who are seeking ways to get more taxes, rather than to reduce the public expenditures which necessitate them, will receive a shock when they return to their constituencies for the next political campaign and encounter the prevailing public sentiment for reforms in government. The people of Great Britain recently voted overwhelmingly for balancing the government budget, and against the socialistic policies of government interference, subsidies and doles which were driving that country toward ruin. The people of the United States will likewise turn out of office at the first opportunity officials who do not learn that the public has discovered that "soaking the rich", and raiding the public treasury for purposes contrary to every sound economic principle is not the royal road to prosperity.

The development of this new and militant public sentiment is of more importance to the railroads than to any other industry, excepting perhaps agriculture, because the railroads have suffered more, directly and indirectly, from government interference, government subsidies and excessive taxation than any other industry. Government interference has deprived them of the power to fix their own rates, and, at the same time, has so fixed their rates that the return earned by them has steadily declined, has been lower during the last decade than in any previous equal period in their history, and has brought them to the verge of general bankruptcy.

The railways have suffered greatly from excessive taxation, their taxes having increased 70 per cent in the ten years ending with 1929 and almost 375 per cent in the twenty years ending with 1929. They have suffered severely, and during the present depression as never before, from direct and indirect government competition with them—from the operation by the government at a loss of a barge line on the Mississippi river system, from the operation of boats on inland waterways ap-

proximately one-half of the cost of transportation upon which is borne through subsidies paid by the taxpayers, and from the operation of buses and trucks which are subsidized through inadequate charges for the use of highways provided and maintained at public expense.

This government discrimination against the railways includes allowing these other carriers, including the government's own barge line, to indulge in every unfair practice in the rendering of service and the making of rates to which the railways have properly been prohibited from resorting. In addition, these other carriers not only pay much lower wages than the railways, but are allowed to work their employees much longer hours. Although the railways handle the great bulk of the nation's traffic, the number of persons killed annually upon our highways is six times as great as the number, including trespassers, killed upon the railways. Nevertheless, the railways are subjected to strict and very expensive regulation in the interest of safety while no comparable regulation is applied to the much more dangerous operation of large buses and trucks upon the highways.

The railroads are one of our very greatest industries, but their ability to pay reasonable wages, to maintain and improve their properties, and to render satisfactory service to the public without unfair discriminations in rates, as well as their financial solvency, will soon be destroyed unless the public sentiment that is now demanding wholesale retrenchment and other reforms in government also effectively demands revolutionary reforms in the present policies of the state and national governments in dealing with transportation.

It cannot be too strongly emphasized that this depression, which has been unprecedented in its length and severity, has disclosed to every thorough and thoughtful student of economics that our most important and difficult business problem has become the problem of deflating government and reducing its destructive activities. During the last ten years, while industry was increasing its efficiency and reducing its unit costs, our governments were constantly neglecting their proper functions, increasing their interference with business, reducing their efficiency and increasing their costs. During this depression the railways have reduced their operating expenses 40 per cent, while the total expenditures of government have largely increased. If our governments, local, state and national, had reduced their expenditures during the depression as much in

proportion as the railways have reduced their operating expenses the saving in taxes to the public in 1931 would have largely exceeded the total earnings of the railways last year.

In 1913 total railway earnings were slightly more than three billion dollars, and total government expenditures slightly less than that amount; while in 1931 total railway earnings were about four billion three hundred million dollars and total government expenditures about fourteen billion dollars. The increase between these years in the amount the public paid for railway transportation was about 33 per cent, while the increase meantime in the amount it paid for government was 380 per cent, or relatively 12 times as great. Nevertheless, we have politicians who have helped to cause this enormous increase in the cost of government and who refuse to do anything to reduce it, who tell us that the commerce of the country will not stand letting the railways earn enough to maintain and improve their properties. All kinds of costs have been deflated in this country excepting the cost of government. What the country cannot stand is not the legitimate and necessary costs of transportation and industry, but the illegitimate, unnecessary and reckless expenditures of our inflated governments. This deflated nation cannot continue to support enormously inflated governments.

We entered a new era in the history of American railroads on January 1, 1932. At the end of 1931 the situation of our railways was, in most important respects, the worst ever known. There had been no such over-expansion due to the building of new mileage as caused the severe crisis in railroad affairs during the depression in the nineties, and there was not so large a number of railways in receivership; but the average percentage of return being earned upon the total investment in the properties was much less than then, and a larger proportion of the railroads was approaching bankruptcy than actually became bankrupt in the nineties. The average return earned upon property investment in the terrible year 1893, when a larger part of our railroads became bankrupt than in any other year, was 3.2 per cent, while in 1931 it was only about 2 per cent. Never was the percentage of return earned upon railroad investment so small. Never did railroad securities sell at such low prices. Never were such retrenchments made. Never, in consequence, were purchases so reduced and so many railroad men thrown out of employment.

The first quarter of 1932 is now drawing toward its close. It has been disappointing. At the end of the year 1931 there went into effect an advance in freight rates granted by the Interstate Commerce Commission, which it had been estimated would yield at least $100,000,000 annually; but undoubtedly it did not yield anywhere near one-fourth of that amount in the first one-fourth of the year because freight business was smaller than anticipated, having been about 40 per cent less than in the first quarter of 1929, 35 per cent less than in the first quarter of 1930, and even 21 per cent less than in the first quarter of 1931. There also went into effect on February 1 a 10 per cent reduction in wages which it was anticipated would save at least $200,000,000 this year.

In spite of both this advance in rates and this reduction in wages, the net earnings of the railways during the first quarter of this year, because of the small volume of traffic moved, will be extremely unsatisfactory; but I am one of those who believe that tendencies are much more important than conditions. Conditions are what we feel, while tendencies are what make them, and although conditions in general are probably as bad at present as at any time since this depression began, I am firmly convinced that economic tendencies are now the best that they have been at any time since the depression began, and I am especially encouraged by the uprising against reckless government expenditures which is occurring in all parts of the country.

When a real depression comes it renders it necessary to make many important economic readjustments to restore prosperity. Immediately after the collapse of the stock market in the fall of 1929 we began to do all we could to prevent the reductions in wages and other economies in business, and especially the reductions in government expenditures and taxes, which the depression made absolutely necessary. At last almost all classes recognize the fact that numerous important readjustments must be made in order to restore prosperity, and are engaged in making them. Railway freight business depends, of course, upon the condition of general business, and as bad as freight business recently has been I believe I can see signs of improvement, and am still confident that traffic will increase during this year, and if this expectation proves correct both the railway situation and the situation of railway equipment and supply manufacturing companies, which are dependent upon the railways for their market, will improve.

It is only too plain, however, that the railroad problem has not been solved. Both the rate advance and the wage reduction will be temporary, as will be the relief from loans now being secured from the government. They will be stimulants to carry the sick patient through the crisis, not remedies that will permanently cure his malady. Permanent remedies must be found and used. Those of us who are closely identified with the railroad industry must not rely upon others to determine what the remedies are and to get them applied. The future of the railways will be determined mainly by railway financiers, railway officers and employees and other persons who understand railroading and have a direct and selfish interest in the solution of the railroad problem.

Probably we can best anticipate the experience of the future, and most intelligently decide how to make that experience more satisfactory than that of the past, by considering experience in the recent past and the reasons for it. In this endeavor I shall compare developments on the railways between the years 1919 and 1930, first, because the former was the last year of government operation and the last before the Transportation act went into effect; second, because there were substantial declines of freight business in both of these years, but the amount of freight business handled in them was about the same; third, because total earnings were almost the same, and, fourth, because in spite of these similarities between the two years, numerous momentous changes occurred between them.

I shall not say much about the depression and its effects upon the railways because the conditions that have caused the railways to suffer worse from the depression than any other industry were, in my opinion, created before the depression began. It is true that in my comparisons I shall use figures for the depressed year 1930, but as we look back now we realize that 1930, in which railway freight business declined only about 14 per cent, was a year of only comparatively mild business recession, and that the full fury of the depression did not strike us until 1931, when freight traffic was about 30 per cent less than in 1929.

Between 1919 and 1930 railroad investment increased from $19,300,020,000 to $26,001,000,000, or about $6,700,000,000. Meantime railroad capitalization increased only $3,244,000,000, or less than one-half as much, indicating that more than $3,500,000,000 of earnings were invested in the properties without being capitalized. These figures demonstrate that during this

period railroad financing was extremely conservative—that more than two dollars were invested in the properties for every dollar of funded securities and stock that was issued. No such conservatism in financing was shown by any of our governments or by any other large industry.

In 1919 operating expenses were $4,400,000,000, and in 1930 only $3,931,000,000, a reduction of $469,000,000; but the changes in operating expenses that occurred were much greater and more important than these figures indicate. Of the total reduction mentioned, $191,500,000 was made in other items and $277,500,000 in wages. Every one of you knows, however, that wages were not reduced, but increased, during this period. The average hourly wage paid in 1919 was 56.3 cents, while in 1930 it was 67.8 cents, an advance of 20 per cent. How, then, was the total amount of wages paid reduced? The answer to this question affords the most illuminating and convincing evidence possible of the great increase in the efficiency and economy of operation that was effected during the eleven years following the restoration of the railways to private management.

The total number of employees in 1919, under unified government operation, was 1,913,422, and the average number of hours worked by each employee was 2,630. The number of employees in 1930 was only 1,487,730, and the average number of hours worked by each employee was 2,527. If the railroads had employed labor as many hours in 1930 as they did in 1919, and paid the average hourly wage of 1930, their total payroll in 1930 would have been $3,412,000,000. The actual payroll in 1930 was $2,551,000,000. Therefore, the **constructive** saving in wages in 1930, as compared with 1919, due to the reduction in the number of hours that labor was employed, was more than $961,000,000. Add to this the actual reduction in other expenses of $191,500,000, and we have a total constructive reduction in operating expenses in 1930, as compared with 1919, of about $1,153,000,000.

I have sometimes heard it intimated that one reason for the financial difficulties of the railways during this depression has been that they invested too much capital and issued too large a volume of securities during the period of active general business. If, however, they had not made this large investment in improvements they could not have made the huge economies in operation that they effected. Allowing in these calculations, as I have, for the effect of the increase in the average wage per hour, the figures show that the economies in operation

represented by the results of 1930, as compared with those in 1919, would have paid a return of 35 per cent upon the entire increase in railroad capitalization in 1930, as compared with 1919, and a return of 17 per cent upon the entire increase in investment.

To what extent did changes in traffic and in the amount of service required contribute toward making these great economies possible? Freight business increased 5⅓ per cent between 1919 and 1930 and passenger business declined 42 per cent. The fact that passenger business declined more than freight business increased may seem to indicate that there was a net decline in the service rendered which helped to reduce operating expenses, but this was not the case.

Although the railways were under unified government operation in 1919, the distribution of freight cars was much less satisfactory than in 1930. In 1919 "car shortages" were reported throughout the year, and were very large in the latter part of the year, while in 1930, 100 per cent of the requisitions made by shippers for cars were promptly filled. This improvement in the distribution of cars was very valuable to shippers, but it was also expensive to the railways. It has been found necessary, in order to so distribute cars that they will always be available where every shipper wants them, to increase greatly the empty movement of cars. The mileage made by empty cars in 1919 was only 32⅓ per cent of total freight car mileage, while in 1930 it was almost 39 per cent, and total freight car mileage, loaded and empty, in 1930 was actually 26 per cent greater than in 1919.

Not only were the distribution of cars greatly improved and car shortages abolished, at the cost of this large increase in freight car mileage, but the speed of the service rendered was correspondingly increased. The average distance each freight car traveled daily in 1910 was 23 miles, while in 1929, it was 32.4 miles, and in 1930, in spite of the decline in traffic, it was 28.7 miles. The average speed of freight trains in 1919 was only 10 miles per hour, while in 1930 it was 13.8 miles and in 1931 almost 15 miles. All these improvements in freight service tended to increase both capital and operating costs, and the large reductions in operating expenses effected were made in spite of them.

When we turn to the passenger business we find that despite the reduction of 42 per cent in passenger traffic, there was only a negligible reduction in passenger train miles and

an actual increase of about 7½ per cent in passenger car miles. In consequence, average passengers per train declined from 82 in 1919 to 49 in 1930, and average passengers per car from 21 to 11. The Interstate Commerce Commission regards the failure to reduce passenger service more as due to wasteful competition, and as justifying criticism of railway management, and it is right, although the principal losses are incurred in rendering the almost irreducible local service; but even the facts about passenger service, like those regarding freight service, help to demonstrate that the huge economies effected were not made by reducing or impairing service, but in spite of the maintenance and improvement of it.

Now, let us see what changes occurred in what the public paid and the railways and railway investors received following these improvements in service and the effecting of these economies. In calculating the total net amount that the public paid for railroad service we must give weight to some factors besides the total earnings, and especially to taxes. In 1919, the railways being under government operation, their net return was guaranteed. Their total earnings were $5,145,000,000. If we add to this amount the deficit of about $510,000,000 which they incurred, and which had to be paid by the taxpayers of the country, and then subtract the $233,001,000 that they paid in taxes, we find that the net amount that the public paid for its railway transportation in 1919 was $5,422,200,000. There were, of course, no government guarantees in 1930. When we deduct from the $5,281,190,000 of total earnings made in 1930 the $348,554,000 that the railways paid in taxes, we find that the net amount paid by the public for its railway transportation was $4,932,643,000, or almost $490,000,000 less than in 1919.

You have often heard the claim made by such tribunes of the people as Senator Brookhart of Iowa that the public cannot afford to continue private ownership and management of railways because, under that policy, the cost of railway transportation is constantly increasing. The figures I have given demonstrate, however, that in 1919, the last year of government operation, railway transportation actually cost the people about a half billion dollars more than it did in 1930.

Even this figure, however, is much less significant than all the facts. I have already shown how much greater would have been the railways' bill for labor in 1930 than it actually was if they had employed as many men as were employed under government operation in 1919. Let us, however, make another cal-

culation based upon the number of persons actually employed in 1930. Under government operation in 1919 the average wage per hour paid to the railway employees who so largely helped to elect Senator Brookhart was 56.5 cents, while in 1930, under private operation, it was 67.8 cents. If the railways in 1930 had employed only the number of men that they actually did employ in that year, and had paid them only the average wage that was paid in 1919, their payroll and total operating expenses in 1930 would have been $426,423,000 less than they were. The reduction in the total net amount that the public paid for railway transportation was made in spite of this advance in the average wage.

Another assertion frequently made is that freight rates have been largely advanced since the railways were returned to private operation and are still being advanced. How much higher were they actually in 1930 than in 1919, and how much did their increase cost those who paid them? Average revenue per ton mile in 1919, when a large deficit was incurred under government operation, was 0.973 cent, and in 1930 it was 1.063 cents, an advance of 9.2 per cent. Applied to the freight business of 1930 this advance in rates cost shippers in that year about $325,000,000, or $100,000,000 less than the increase in the average hourly wage made between 1919 and 1930 cost the railways in 1930. Consequently, if there had been no advance in rates and no advance in wages the railways would have earned about $100,000,000 more net operating income in 1930 than they did. Railway employees, through the increase in their average hourly wage, got that much more in 1930 than all the increased revenue resulting from the difference between the average freight rates of 1919 and 1930.

The increase in the average hourly wage was 20 per cent, while the increase in the average freight rate was only 9 per cent. Men such as Senator Brookhart have got themselves elected by telling the farmers that their freight rates were too high, and at the same time telling railway employees that their wages are too low. Obviously, the railways could not forever stand such large advances in wages without advances in rates, and nothing could be more conclusive evidence of the increase in their efficiency of operation than the facts that they stood a 20 per cent increase in wages with only a 9 per cent increase in freight rates, while greatly improving their service and suffering a loss of a half billion dollars annually in the total net amount that the public paid for that service.

So much for what the public paid to and received from the railways, and what their employees received from them. What did the railways gain by the large increase in their investment, the improvements in their service and the huge economies they effected? Less than nothing at all. In 1919 they earned $455,000,000 net operating income and received about $501,000,000 under the government guarantees which were based upon the average earned annually by them in the three years ending with 1917—a total available for paying interest and dividends of about $956,000,000. In 1930, after having increased their investment almost seven billion dollars, they earned a net operating income of only $869,000,000, or 3.27 per cent upon their investment.

But, it will be said, 1930 was a year of depression. Yes, it was a year of depression, and freight business declined 14 per cent; but in spite of that the railways actually handled more freight than in 1919, rendered better service, paid more taxes, paid the highest average hourly wage in history, and incurred operating expenses of almost a half billion dollars less than in 1919. Why, then, even if 1930 was a year of depression, should they have got a much smaller return upon an investment of about $26,000,000,000 than they got in 1919 (including government guarantees) upon an investment almost seven billion dollars smaller? And why, pursuing the matter a little farther, did they in 1931, even though it was the year of severest depression in history, earn a net operating income smaller than they earned in 1902 upon an investment less than one-half as large as that of 1931?

This comparison of the experience of the railways in 1919, the last year of government operation and the last before the Transportation act was passed, and in 1930 and 1931, so long after it was passed, brings us to the crux of the railroad problem of the future. The Transportation act was passed to restore the railways to private operation and to solve the railroad problem under the policy of private ownership and management. The facts that I have given, and other facts with which every student of railway affairs is familiar, show that the Transportation act has utterly failed to accomplish its purpose, and that the railrad situation and problem are more serious and difficult now than they were before it was enacted. Why, I repeat, did the railways, with such a record of achievement in conservative financing, improvement in service and increases in the efficiency and economy of operation, earn such small returns in 1930 and 1931, and especially in 1930, when their

freight business was only 14 per cent smaller than the maximum reached by it in 1929? The answer to that question is to be found in the record of the years from 1922, when a general reduction of freight rates was made, to 1929.

The Transportation act assured railway investors and managers that, if operation was honest, efficient and economical, the Interstate Commerce Commission would so initiate and adjust rates as to enable the railways to earn annually, "as nearly as may be," a fair return upon a fair valuation, and the commission held that a fair return would be 5¾ per cent. The phrase in the law "as nearly as may be" plainly meant that the return made in any year might be somewhat more or somewhat less than a fair return. The net result of all that was done was that it was always less. Calculating on the basis of property investment, an average return of 5¾ per cent would have produced an average net operating income in the eleven years ending with 1931 of $1,400,000,000 annually. Calculating on the commission's own valuation basis it would have produced an average of $1,275,000,000 net operating income annually. The net operating income actually earned averaged only $959,000,000, or 3.95 per cent on property investment and 4.33 per cent on the commission's own basis of valuation. The railways actually earned an average of $315,000,000 a year less than the commission itself held that they were entitled to earn, in spite of all the great economies and improvements in service made.

Now, it is beyond question that investors furnished to the railway companies the vast amount of capital that was invested during those years, relying upon fulfillment of the assurances given in the Transportation act. That they have been greatly disappointed, that they have lost faith in railroad securities, that the credit of the railroad industry has been largely destroyed, is made clear beyond question by the fact that railroad securities of all kinds recently have been selling at the lowest prices in history and at relatively much lower prices than the securities of other large industries. That progress in developing the art of railroad transportation—in improving service and effecting economies—will be arrested until this condition is corrected requires no demonstration. The advances in freight rates recently authorized by the commission, the recent decision of the Supreme court reversing the commission's decision in the grain rate case, and the prospective general reduction in railway wages are already tending to correct it. But much more than

these things must be done if progress in railroading is to be revived.

The necessity for reviving progress in railroading is greater than it ever was. The railroads are still much more important and essential than all our other means of transportation combined. They are, however, confronting new and difficult conditions upon every hand. They are meeting with unprecedented competition from carriers by pipe line, water and highway for both passenger and freight business, local and long distance. They are paying as high wages as in 1923, after a ten per cent reduction has been made, and the reduction is only temporary. The principal thing needed to increase their net earnings is, of course, a revival of general business and an increase of freight traffic, and these will come, as they always have. But freight business increased only nine per cent from 1920 to 1929. Does this indicate that freight business has permanently ceased to grow as it did before the war? Passenger business has declined one-half since 1920. Will it continue to decline or can its decline be stopped and a substantial part of what has been lost be recovered?

The experience of the past decade and the situation now existing clearly indicate certain things. Commodity prices have declined, and owing to this and the competition of other carriers general increases in freight rates cannot reasonably be expected in the future, although increases on numerous specific commodities may be justifiable and unwarranted reductions must be successfully resisted. Large economies in operation must continue to be effected, and every practicable means to that end must be adopted. Freight and passenger service must be radically changed and improved. Conditions must be met that present great problems, but also great opportunities, to the managements of both the railways and of the railway equipment and supply manufacturing industries. It is probably no exaggeration to say that the present railway plant must be made obsolete by revolutionary changes in rolling stock and in permanent structures. The necessary improvements must be initiated principally by the manufacturers; but railway officers must be ready open-mindedly to test in service every improvement in equipment or devices that is offered to them, and to adopt and install it as soon as its merits have been proven.

But whence are to come the means for making these improvements? Improvements to better service and reduce expenses must practically all be made by the investment of new

capital; and the huge amounts of capital required to revolutionize the physical plants of our railways cannot be raised unless the confidence of investers in the future of the railroads is re-established.

It is the function of managament to initiate and carry out the policies necessary to improving the conditions of an industry, and we frequently hear it said that if the managements of the railroads would meet competition as the managements of companies engaged in other lines of business do, and do other things as the managements of other industries do, the railroads would get along all right. After reflection I have concluded that that statement is correct, but I am sure that, as meant by those who usually make it, it is entirely misleading. The trouble with it, as it is usually meant, is that it puts the entire responsibility for railroad management upon those who have only part of the power of management. The fact is that our railroads now have two managements. The words "regulation" and "management" as applied to them have become complete misnomers.

The Interstate Commerce Commission is no longer merely a regulating body. It is exercising more and more of the power, and performing more and more of the functions, that are exercised and performed in other industries by the managements, and proposals are now being made for increasing its powers, such, for example, as for giving it the power to regulate the amount of dividends that may be paid. Most of the people of this country profess to fear the results of government management of railways, and say that we must spare no effort to avoid it. They overlook the fact that we already have a very large measure of government management; and the question as to whether the railroad problem can be solved is largely the question as to whether any industry can be successfully conducted under two managements, and, if not, as to which management shall give way.

We all concede that the public interest in the way in which our railways are managed and operated is paramount; and what the public needs and wants is good and adequate service and the lowest rates that are consistent with the rendering of such service. But the most fundamental principle of railroading that can be stated is one that is being constantly disregarded in our so-called "regulation", and is that the kind of service a railroad can render and the rates it can afford to accept are determined by every single thing that is done which affects its develop-

ment, maintenance or operation, from the draining of its roadbed, the laying of its rails, the ballasting of its tracks, the desiging of its yards and equipment, the making up and moving of its trains, and the selection of its officers and directors, to the issuance of its securities, the fixing of its rates, and the determination of its net operating income.

Draw a line through the annual statistics of the railways, leaving only the figure of their net operating income below it, and you will have above that line all the figures regarding their gross earnings, and also regarding their operating expenses and taxes. On the average, the figures of net operating income below the line during the last eleven years has been only about 15 per cent of annual gross earnings, while the figures above the line have accounted for the disposition of about 85 per cent of gross annual earnings, of which about 6½ per cent have been paid out in taxes and about 78½ per cent in meeting operating expenses. The operating expenses from day to day are determined by the service rendered and the way the properties are maintained; but one of the most prevalent, entirely fallacious, and most destructive theories regarding railroading is that there is little or no interdependence between the figure of net operating income that appears below the line I have mentioned, and the figures of operating expenses that appear above it. The net operating income is regarded as merely the part of the earnings that is available to be paid out in interest and dividends to the owners of funded securities and stock, and it is subjected to what is called "regulation" on the assumption that the only effect of limiting or reducing it is to limit or reduce the amount of interest and dividends that can be paid. It is assumed that while, if no dividends, or even interest, are paid, the effects upon the owners of securities will be disastrous, there will be no adverse effects upon the service that can be rendered or the rates that the public will have to pay.

It is assumed, on the same stupid and destructive theory that it is entirely the responsibility of what is called the "management" to keep down or reduce operating expenses and protect the railways' traffic against the competition of other means of transportation, and that if this agency called the "management" does not do these things it should be held responsible and criticized for lack of vision and efficiency. The Transportation act itself makes the legal right of the railways to earn a "fair return" conditional upon "honest, economical and efficient management," and thus tacitly assumes that there can be such

management without a fair return being earned, and that unless there is such management such return ought not to be allowed to be earned.

Now, that I think that the Transportation act is the most constructive piece of railway legislation ever enacted, and that if it had been carried out during the last eleven years as its authors intended the situation in the railroad industry would be entirely different from what it is. But what I want to emphasize is that there is the closest possible relationship and interdependence between the net operating income earned, on the one hand, and the service that can be rendered and the operating expenses that must be incurred, on the other hand, because the net operating income alone determines how much capital can be raised for improvements, and that therefore unless adequate net operating income is earned it is impossible to long have efficient and economical operation, and without efficient and economical operation the public cannot have good railway service at the lowest rates consistent with such service.

In what way have all the important improvements in railway service and economies in railway operation been effected? Excepting the increase in safety, which has been principally due to a reduction of man failures, they have all been effected by making improvements in the physical plants. Fast and dependable passenger service cannot be rendered excepting upon tracks made straight and level and strong by the elimination of curvature and grades, by the introduction of heavy rail, by the application of good ballast, by drainage of the roadbeds and by the use of the best locomotive and car equipment. Fast, dependable and economical transportation of freight depends also on constant improvement of the permanent structures and the development, acquisition and use of locomotives and cars which, when coupled together in longer trains, will be able to maintain and increase speeds without corresponding increases in fuel and other expenses.

The total earnings made in any year therefore determine the amount a railway can spend in that year for operation; but it is only the amount of net operating income earned which determines how much can be spent upon improvements, and as the improvements that can be made in the properties determine in the long run the kind of service that can be rendered and mainly determine all the important economies that can be made in operation, it follows that whoever or whatever determines the amount of net operating income that can be earned

also settles the kind of service that can be rendered to the public and the rates that the public will have to pay in order to provide enough revenues to defray operating expenses.

But what has what we ordinarily call the "managements" of our railways to say about how much net opearting income they shall earn? Almost nothing at all. They can effect every reduction of operating expenses within their power, and the Interstate Commerce Commission, by the stroke of a pen, can make a reduction of rates which will prevent the economy effected from resulting in any increase whatever in the net operating income earned. I have shown already that in 1930, as compared with 1919, there were effected the equivalent of $1,153,000,000 in operating economies, and that, nevertheless, in 1930 the income available for paying a return upon investment of $26,000,000,000 was almost $100,000,000 less than the income that was available in 1919 for paying a return upon investment of only about $19,000,000,000. The solution of the great problem of reviving and continuing the development of the art of railroad transportation will never be accomplished until we find a way to stop something that has been going on for 25 years—that is, a decline in the percentage of return earned on railroad investment in every period of prosperity as compared with the return earned in the last preceding period of prosperity, and a decline in the percentage of return earned on investment in every period of depression as compared with the last preceding period of depression, until finally in 1931 the return became only two per cent, the lowest in all railroad history.

This downward trend of the percentage of return earned upon railroad investment has been attributed to various causes. It has been attributed to loss of passenger earnings and decline in the growth of freight business during the last decade. The fact is, however, that the trend of the return earned was upward from the end of the depression of the nineties until 1906, in which year effective federal regulation of railways was begun, and then turned downward from 1906 until the adoption of government operation at the end of 1917, although throughout this entire time from 1897 to the end of 1917 both passenger and freight traffic were growing rapidly. What changed the trend after 1906, unless it was regulation? The failure to earn larger returns since the Transportation act was adopted has been attributed largely to competition between the railroads themselves, and it has been claimed that without government regulation they would ruin themselves by such competition; but

if that is true, what is the explanation of the fact that the return earned constantly increased, from the depression of the nineties until effective federal regulation was adopted in 1906, in spite of competition between the railways, and that it was relatively larger in 1905-1907, inclusive, than in any other three consecutive years before or since? The failure to earn a fair return under the Transportation act also has been attributed largely to "whittling" of the rates by the railways themselves and to the increasing competition of other means of transportation. The Interstate Commerce Commission undoubtedly is right in saying that fear of big shippers has caused the railways to reduce many rates that should not have been reduced and to fail to seek advances in many rates that should have been advanced. It remains true, nevertheless, that with freight rates averaging only seven per cent higher throughout the decade ending with 1930 than those actually in effect the railways would have earned an average of 5¾ per cent on the commission's own basis of valuation; that it was the commission that caused a 10 per cent reduction of rates in 1922; that refused a 5 per cent general increase to the western lines in 1926; that ordered a reduction in the rates on deciduous fruit under the Hoch-Smith resolution, that fixed distance class rates almost throughout the country; that ordered the reduction in grain rates regarding which the Supreme court recently rendered an adverse decision; and that these acts of the commission alone are far more than sufficient fully to explain the constant failure of the railways since 1920 to earn the return assured them by law.

It is true that the railways have lost a large amount of traffic to competing carriers that have been subsidized by the state and national governments without being regulated; and full credit should be given the commission for the constructive recommendations recently made by it for dealing with the problem presented by this subsidized and unregulated competition. But when the subject has been considered in all its aspects the conclusion is inevitable that the complete failure of the railways to earn a reasonable return during the last decade has been principally due to the commission's persistence in pursuing a policy of restricting earnings more than conditions warranted.

In view of all the facts, it seems to me that what must be done to assure the future of the railways and thereby enable them to perform their essential function in promoting the economic welfare of the American public is not seriously debatable

by those who can learn from experience. There must be a continuance of efforts by manufacturers to develop and improve equipment, materials and supplies, and by railway officers to effect every practicable improvement and economy in service. There must be what Commissioner Eastman has described as "a greater degree of co-operation on the part of railroad managements which will reduce competitive wastes in service and thus lower costs materially, and also reduce timidity in dealing with various rates." There must be a withdrawal of subsidies from competing means of transportation and application of comparable regulation to all carriers in order that there may be established equality of opportunity between them in competing for all traffic. But there must also be revolutionary changes made in our federal regulation of railways, because such regulation as has prevailed during the last decade would defeat all efforts to establish the necessary future earning capacity of the railways.

In its regulation of rates and in many other ways the Interstate Commerce Commission has actually become a large part of the management of the railways of the United States. It not only determines the general level of rates, but the extent to which distance, and especially the legal provision regarding rates for long and short hauls, can be disregarded to meet the competition of coastwise steamships and carriers by highway and inland waterway, Recent decision. As long as these other carriers are free to make their rates as they please the railways cannot meet their competition for traffic with rates established more and more on a distance basis and constantly made more inflexible. The commission's policy has been not only to make the general level of rates too low, but also to so regulate them as to prevent the railways from meeting competition, and it has needlessly curtailed railway earnings in both ways. If the commission is to continue to exercise so much of the power of management it should be forced to assume responsibility for the results of its participation in management; and if it is not going to assume that responsibility then its power should be correspondingly reduced, because we have seen too much already of its exercise of power without responsibility. If the commission cannot or will not so regulate as to enable the railways to maintain and improve their properties as the public welfare demands, then the initiative in fixing rates should be restored to railway managers.

From the time the commission made a 10 per cent reduction in freight rates in 1922 until the beginning of this depression I constantly criticized its policy upon the ground that, as it was resulting in the railways earning much less than a fair return in years of prosperity, it was sure, if persisted in, to plunge the railways into serious difficulties when a depression came again. The outcome having been what I had so long predicted, I have also during this depression, and especially since the decision in the 15 per cent rate case, repeatedly asserted that the commission was principally responsible for the desperate financial plight to which the railways have been reduced, and said that either it must follow a widely different policy in future or its power must be reduced or government ownership cannot be avoided. My recent criticisms of the commission have been commended by many persons, but they have also caused me to receive communications from some who have indicated a belief that in imputing unfairness, disregard of law and lack of foresight to it, and suggesting that probably the railroad problem cannot be solved without a reduction of its power, I have been attacking the very Ark of the Covenant.

There seem to be a good many commentators of railway matters who learn all they know about railroading from the opinions and reports of the commission, and who believe that whatever it says regarding railroad matters is conclusive and final. Having been myself for more than 25 years a diligent student of railroad organization, development, management, operation and maintenance, and having followed every step in the development of effective federal regulation, I decline to accept as conclusive and final either the statements of fact, the opinions or the decisions of men who have had much less opportunity to study the problems of the railroad industry, and who have devoted much less time and energy to that study, than I have. Mere appointment by the President and confirmation by the Senate as an Interstate Commerce Commissioner does not instantly translate into a transportation expert a man who did not previously have any knowledge or ideas about the railroad business excepting the prejudices usually characteristic of the bucolic mind; and I believe the time has come when railway officers and others closely identified in interest with the railroad industry should cease to participate in a conspiracy of silence regarding the commission and its policy, and should begin to say in public regarding them what they say in private. If the railroad industry cannot be prevented from being ruined

and driven into government ownership excepting by frank criticism of the commission, as apparently it cannot be, then the danger of voicing such criticism has become much less than the danger of not expressing it, and I, for one, intend to continue to discuss this subject frankly whether any one else does or not, and whether anybody listens to me or not.

I repeat that when we entered the year 1932 we entered a new era in the history of American railroads. Railway investors, railway officers and employees and manufacturers of railway equipment and supplies have it within their power to create the public sentiment necessary to causing a great improvement in railway regulation, and, under improved regulation, to effect all the improvements in the physical plant and in the art of railroading essential to paying as high wages in the railroad industry as are paid in any other industry, and to providing the public with the best railroad service in the world at rates lower than those charged anywhere else in the world or than are now being charged in this country. In order to accomplish these results, however, they will have to co-operate better, work harder and also fight harder than they ever have in the past. I have no serious misgivings regarding the future of the railroads, because I believe the crisis through which we are now passing has given a solemn warning to all who can contribute toward the solution of the railroad problem that they must make their contribution to that end if private ownership is to be saved; and fortunately there is no fact more generally recognized and accepted by the American people than that only under private ownership can they expect to have good railroad service at a reasonable cost.

PRESIDENT: Gentlemen, we certainly ought to appreciate this very wonderful message that Mr. Dunn has brought to us tonight. We will be glad to hear from any one from the floor who may desire to discuss this subject further. Mr. Dunn will, I am sure be glad to answer any questions in connection with the subject.

MR. H. M. SPERRY: I think that Editor Dunn is forceful and effective and that he is making a splendid fight for the railroads. We should stand behind him.

I heard the Chairman of the Interstate Commerce Commission in Chicago. He began by making a strong defense of the Commission and went on to explain its position. He told men

present who were Presidents of railroads and men of the very highest ability what steps they should take.

I think the railroad managements, if their hands were left free, could solve our railroad problem very quickly.

PRESIDENT: Anybody else? We are honored tonight by having with us one of the executive officers of our largest railroad, and on account of this very important subject I feel that I am justified in calling upon him for a few words, Mr. John F. Deasy, Vice President of the Pennsylvania Railroad.

MR. J. F. DEASY:

Mr. President, Members of the Railway Club of Pittsburgh, and honored guests:

For one to be called upon to make any kind of a statement after listening to that very interesting address by Mr. Dunn is rather a difficult task. As he was reaching the climax of his speech I was proud of one situation and that is that I am identified with the managing agency and not the commission agency. Mr. Dunn has done us a great favor to come here and deliver this very interesting address and I know that I bespeak the sentiments of the audience when I say to Mr. Dunn "we thank you."

I think we of the railway business have a lot of confidence in Mr. Dunn and what he writes, and whenever he talks he has our attention. We do not, of course, always agree with him, but nevertheless we recognize in him an authority in the matter of the interpretation of the trends of the times as it affects the railroad business.

Railroad development in this country might briefly be divided in three periods:

1. The period of railroad expansion.
2. The period of intensive internal development of the efficiency of the plant.
3. The period of expansion into new methods of transportation required by the growth and progress of business.

American railways are now entering upon the third stage. Their success obviously in this period will depend upon their ability to meet the exigencies of the changed conditions. The problem is obviously a difficult one, but what is difficult is interesting and I should like to suggest that we are entering upon our most interesting period.

I did not come here to make a speech. I came here to listen to Mr. Dunn. We discussed the matter of speech making at the dinner table and he asked me, or perhaps I asked him, if speech making did much good. I did not know him so well and was rather timid about committing myself. I gathered, however, that he thought it was worth the effort.

Another incident impressed me very much as I was coming into the room tonight and that was a statement of a gentleman employed by one of the railroads in the Pittsburgh district. I do not propose to tell you which railroad. He told me that it required three weeks to prepare every speech he made. I shook my head and said nothing, but I thought that some day I should like to take the platform and make a speech on the futility of speech making. I am perfectly willing to leave the speech making to the people who enjoy it, understand it, and can do it, and devote my time to the operation of our railroad.

I am rather optimistic as to the future of the railroads. Each person must obviously have a supreme interest and enthusiasm in the business in which he is engaged, because if he loses these important elements he can not courageously meet the issues of present day business conditions.

Again reverting to the different modes of transportation as mentioned by Mr. Dunn. I have given the problem a lot of consideration, because it affects our earning power. I do not propose to enter into a detailed discussion of our policies and program tonight. Suffice it to say that the most prominent and debatable feature is the matter of regulation as it affects the railroads and their competitors—highway transportation.

I have mentioned only highway transportation because I think it useless to talk about water transportation. Everyone knows that it is a mode of transportation that could not successfully compete with rail transportation. It has been brought back to life in a parasitical manner, the life being sustained from other forms of economic life. In other words, its existence today depends on the use of the taxpayers money and not on competition with rail transportation. I have reached the conclusion that the thing to discuss today is highway transportation, and I say discuss because it is important that we reach a common understanding and a common working arrangement as between the railroads in order to successfully meet the issue.

Our studies indicate quite clearly that the railroads of this country can perform cheaper transportation and better transportation and generally perform quicker transportation between cities than can be performed by its highway competitors. If we can compete on the basis of quicker and cheaper service there should be no question about the future in meeting the competition of the new highway agencies of transportation.

It means, of course, that the railroads will have to introduce some very radical changes in their practices and also probably give the trucker the railroads' expensive job of terminal work and the railroads themselves perform the inter-city haul.

The thing I dislike most about speech making is the fact that you have to talk so much to accomplish any material change to meet the exigencies of present conditions. The conditions have apparead to change faster than we have changed our practices to meet them. Perhaps this problem will be facilitated when the consolidation of the railroads east of the Mississippi into four systems shall have been accomplished. With fewer railroads to deal with and the railroads having a common interest, it seems to me that the advancement in the art will be more rapid than we have been able to accomplish in the past.

My chief function tonight, I take it, is to compliment Mr. Dunn. I do thank him wholeheartedly. I am very happy to be here and to have listened to him. I am grateful also for the privilege of meeting and greeting the members of this Club. I have, indeed, been well paid for the time I have spent here in listening to the very remarkable, very interesting, and very entertaining speech made by our generous friend, Mr. Dunn.

PRESIDENT: We thank you, Mr. Deasy. We have with us also the Assistant to the President of one of the important industrial plants in the Pittsburgh district, and one very much interested in the business of the railroads, Mr. Burt T. Anderson, Assistant to the President of the Union Switch and Signal Company. We would be glad to hear from him.

MR. BURT T. ANDERSON: Mr. President, and Members of the Railway Club of Pitsburgh. It is a pleasure and a privilege to be here tonight and listen to this most interesting and instructive address by Mr. Dunn. His 25 years of close contact with the railways, and his study of their problems from not only the operating and engineering, but also from the financial and regulatory viewpoints, has made him exceptionally

qualified to speak on a subject in which all of us are so vitally interested. I thank you.

PRESIDENT: We usually close these meetings at ten o'clock but the subject has been so interesting that I think if you are willing to bear with me I would like to continue it a little longer, at least until the waiters get the lunch ready, and I am watching them from here.

This Club has always been fortunate in having on its Executive Committee men who have its interests closely at heart. One of them who has been a member of that Committee for a good many years is here tonight, indeed he very seldom misses a meeting. We would like to hear a word from Mr. Frank J. Lanahan, Chairman of the Executive Committee.

FRANK J. LANAHAN:

Mr. President and Gentlemen: In a dilemma am I as to whether the President in calling upon me for remarks, desires that I speak from the point of view of transportation, or as a manufacturer of railway supplies. I would prefer to indulge in the theme of friendship for there has been an affectionate relationship of years standing where Sam and I are concerned. To-night you have heard the gentleman spoken of as Mr. Dunn, and as Colonel Dunn, but did you notice he prefaced his talk by alluding to us as "fellow members," therefore, it is fitting to call him "Sam," for he is a mighty genial fellow.

In this excellently prepared paper on the vicissitudes of the transportation systems of the country, Mr. Dunn has stressed the necessity of having the subject agitated and a splendid example has he, himself, set of leadership by weekly hammering away at existing conditions that are slowly sapping the vitality of the railroads of the Nation. Surely this is an activity to be commended and there is no better place in this whole United States to deposit such propaganda than in the Railway Club of Pittsburgh, for every member of the organization is vitally interested in the prosperity of the transportation systems. The complexion of the organization is well illustrated by the attendance here tonight. On the platform but a moment ago was the ranking official, in Pittsburgh, of the Pennsylvania Railroad System, while attentatively listening in the audience were the humble track-worker and the trainman, all proportionately interested in a square deal to the company from which they derive their livelihood. There is not one of us here but is concerned in the facts that have been imparted

by Mr. Dunn. It is but natural to inject the interrogation, "Where then should be a more effective place for stimulating the agitation that has been proposed by the inspiring message to which we have just listened, than in this very Club?"

In these days of popular clamour, our political friends are more susceptible than ever to the "voice of the people," so it behooves each and everyone of us to let our representatives in legislative bodies and regulatory committees know in unqualified language of our personal concern in the detrimental policy that is being pursued in the case of the railroads. If we all do this, it will have a beneficial result, for I can assure you that a majority of elective officials are quite desirous of ascertaining the views of their constituents and are guided by a preponderance of opinion.

The realization is mine of hearing tonight, a splendid address by a close student, careful analyst and an enthusiastic writer on a subject that is paramount to the country's prosperity. A little thought will convince even the "doubting Thomases," that the railroads are the Nation's greatest industry, and that their prosperity is entwined with our individual progress. A perusal of history will reveal that it has been mighty lean picking for the rest of us when the railroads did not enjoy what is commonly called "good times."

Proud are we of the Railway Club, that the speaker of the evening is a member of our organization and delighted are the officers that the Club has turned out in such numbers to pay tribute to this crusader for fair treatment to the railroads. It has been a treat, and the further enjoyment will be ours of reading in the proceedings, what has been our good fortune to hear as delivered.

May I move, Mr. President, a vote of thanks to Mr. Dunn and ask that the expression take the form of all signifying their appreciation by rising?

Motion carried by unanimous rising vote.

There being no further business, on motion, the meeting adjourned.

J. D. CONWAY, Secretary.

In Memoriam

W. J. WILSON,

Joined the Club October 28, 1904.

Died, March 8, 1932.

RESERVED

OFFICIAL PROCEEDINGS

RAILWAY CLUB OF PITTSBURGH

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Track Construction and Roadway Maintenance

By J. V. NEUBERT, Chief Engineer, Maintenance of Way,
The New York Central Railroad Company, New York, N. Y.

OFFICIAL PROCEEDINGS

OF

The Railway Club of Pittsburgh

Organized October 18, 1901

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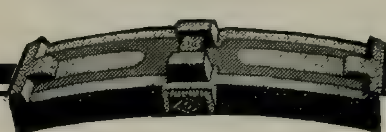

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Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING
APRIL 28, 1932

The regular monthly meeting was called to order at the Fort Pitt Hotel at 8 o'clock P. M., with President J. E. Hughes in the chair.

There were 347 registered in attendance, as follows:

MEMBERS

Adams, W. A.
Allinger, N. J.
Allison, John
Altsman, W. H.
Anger, C. E.
Anthony, R. H.
Arnold, J. J.
Babcock, F. H.
Baker, J. B.
Balzer, C. E.
Barclay, J. R.
Barr, H. C.
Beam, E. J.
Beck, J. G.
Berg, Karl
Bernoulli, W. H.
Bonhoff, E. L.
Brennan, J. T.
Brown, F. M.
Buffington, W. P.
Burnette, G. H.
Callahan, F. J.
Campbell, J. E.
Campbell, J. T.
Carson, John
Christy, F. X.
Connors, John M.
Conway, J. D.
Courtney, H.
Creighton, D. M.
Crenner, Joseph A.
Croke, Thomas F.
Cunningham, J. L.
Dalzell, W. E.
Dambach, C. O.
Davin, W. E.
Davis, Charles S.
Dempsey, P. W.
Dickinson, T. R.
Durkin, James E.
Emery, E.
Emsheimer, Louis
En Dean, J. F.
Endsley, Prof. Louis E.
Evans, David F.
Fink, P. J.
Flinn, R. H.
Forsberg, R. P.
Frauenheim, A. M.
Freshwater, F. H.
Fults, J. H.
Furch, George J.
Gaffney, Thomas H.
Gatfield, Phillip I.
Geddes, James R.
Geisler, J. J.
George, R. H.
Germak, George A.
Gilg, Henry F.
Goff, J. P.
Graham, Harry C.
Grieve, Robert E.
Grove, C. G.
Hackett, C. M.
Hamilton, W. H.
Hanna, R. B.
Hansen, William C.
Harper, A. M.
Hepburn, P. W.
Hervey, R. S.
Hilstrom, A. V.
Holmes, E. H.
Hoover, J. W.
Huber, H. G.
Hughes, John E.
Irwin, R. D.
Johnson, A. B.
Johnston, W. A.

Keller, R. E.
Kelly, L. J.
Kirk, W. B.
Kraus, Raymond E.
Kroske, J. F.
Kruse, J. F. W.
Kummer, Joseph H.
Lanahan, Frank J.
Laughner, C. L.
Laurent, Joseph A.
Layng, F. R.
Lee, L. A.
Leet, C. S.
Longdon, C. V.
Lunden, Carl J.
Lustenberger, L. C.
Lynn, William
Marquis, George E.
Mayer, L. I.
Mercer, B. F.
Merscher, John
Meyers, William F.
Michaels, J. H.
Millar, C. W.
Miller, J.
Miller, R. C.
Misner, George W.
Mitchell, W. S.
Morgan, A. L.
Morgan, Homer C.
McComb, R. J.
McGeorge, D. W.
McIlwain, J. P.
McKenzie, Edward F.
McKinley, A. J.
McKinley, John T.
McLaughlin, L. S.
McNamee, W.
Nagel, James
Nannah, F. J.
Nash, R. L.
Noble, Jesse A.
Orchard, Charles
O'Sullivan, J. J.
O'Toole, J. L.
Paisley, F. R.
Pickard, S. B.
Posteraro, S. F.
Pringle, H. C.
Read, A. A.
Redding, P. E.
Rhine, G. B.
Richardson, H. R.
Robinson, J. M.
Sattley, E. C.
Schmitt, Raymond F.
Schoch, M. G.
Seiss, W. C.
Severn, A. B.
Shannon, David E.
Sharp, H. W.
Sheridan, T. F.
Shield, Arthur
Sinclair, I. B.
Sixsmith, G. M.
Smith, J. Frank
Snyder, F. I.
Snyder, J. J.
Stearns, William G.
Stein, J. A.
Stevens, R. R.
Stewart, L. R.
Stucki, A.
Sutherland, Lloyd
Sylvester, H. G.
Thomas, T. T.
Thornton, A. W.
Toussaint, Robert
Tovey, George F.
Trautman, Harry J.
Trax, L. R.
Unger, Dr. J. S.
Van Blarcom, W. C.
Van Wormer, G. M.
Watt, Herbert J.
Weaver, W. Frank
West, G. S.
Wheeler, C. M.
White, Charles G.
Wiggins, W. D.
Wikander, O. R.
Wildin, George W.
Woodward, Robert
Wright, Edward W.
Wright, John B.
Yarnall, Jesse
Young, F. C.

Arnold, C. C.
Artrip, B.B.
Balph, E. D.
Balph, M. Z.
Barth, W. H.
Bell, R. P.
Berbach, Leo J.
Boyd, John R.
Boyer, S. H.
Brickner, H. E.
Bronson, C. B.
Bruner, T. C.
Bryant, Lewis J.
Buck, E. H.
Cadman, M. M.
Cagney, M. J.
Casey, John F., Jr.
Cavill, C. G.
Caylor, J. H.
Church, S. L.
Clark, Henry F.
Clarke, A. C.
Corbett, Joseph L.
Covert, G. W.
Cromlish, A. L.
Daugherty, Harry L.
Duff, James H.
Egan, Thomas
Elliott, W. R.
Escott, C. M.
Everstine, A. P.
Flatley, N. M. J.
Forst, J. F.
Forsythe, D. B.
Fowler, W. E.
Franklin, H. J.
Galt, Carl F.
Ganderson, G.
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Goodwin, R. E.
Graham, Charles H.
Green, M. E.
Hahn, William L.
Hanna, W. F.
Harper, M. L.
Harmon, H. H.
Hart, William F.
Hartnett, C. J.
Hartnett, T. D.
Henning, C. C.
Herley, James E.
Hohn, George
Hunter, J. M.
Jones, J. Harry
Jones, L. E.
Jones, W. B.
Johnson, H. C.
Johnston, F. D.
Kinsbey, A. H.
Kistler, Thomas E.
Lash, J. F.
Lewis, S. B.
Loos, Albert
Macdonald, G. A.
Maurer, R. M.
Mecusker, M. R.
Murray, J. C.
Murphy, T. A.
McCarthy, F. R.
McWilliams, J. B.
Nall, R. M.
Neubert, J. V.
Newell, J. P., Jr.
Ohnezeit, H. A.
O'Laughlin, M. J.
Oliver, W. E.
Pfrom, E. L.
Pratt, John J.
Pugh, J. R.
Radthe, J. E.
Ralph, W. E.
Reithel, Benjamin H.
Rendleman, Norman
Reynolds, David
Riegler, L. J.
Riggs, J. S.
Robinson, C. M.
Rodkey, H. E.
Rose, A. T.
Ruppert, Max K.
Schmitt, Elmer M.
Shuman, Jesse J.
Simpson, Robert
Smith, F. C.
Smith, Sion B.
Smith, Stanley H.
Snodgrass, Thomas R.
Stark, H. D.
Stein, J. M.
Taggart, J. G.

Taggart, Ross E.
Tripp, W. N.
Underwood, Walter C.
Vandivort, R. E.
Van Wort, C. W.
Vowinkel, F. F.
Warrensford, Fred S.
Watson, J. R.
Watson, T. Lane
Wickerham, F. A.
Woodings, M.
Wright, Robert M.

PITTSBURGH GLEE SINGERS

Professor Maurice Lewis, Director.

Allen, Earl M.
Brednich, C. A.
Buzzard, Alfred
Edgecombe, W. E.
Emanuel, Morgan
Davies, Herbert R.
Dove, P. D.
Fletcher, C.C.
Gwyer, Herbert
Hargest, Lloyd
Harris, David W.
Hays, Milton
Hope, Russell
James, J. E.
James, Samuel
Miller, Morgan J.
Morgan, John S.
Neuser, John, Jr.
Newman, W.
Pillow, Alfred
Richards, Gordon
Roberts, R. R.
Robling, Oliver J.
Stephens, William
Smith, W. A.
Thomas, O. E.
Wood, John D.
Williamson, John C.
Lewis, O. C.

Benjamin, M. A.
Cadugan, Ruth
Callen, Mrs. R. G.
Cowan, Mrs. Clara
Cunningham, Willia
Davis, Ada Jane
Dove, Gladys S.
Evans, May
Freeburn, Mrs. W. B.
Gabosch, Miss La Vera
Greenwald, Mrs. Sophia
Hammel, Mrs. J. R.
Hayden, Ella
Henderson, Jane
Jones, Caroline A.
Lammie, Aramenta
Lewis, Mrs. Maurice
Miller, Mrs. Leonard H.
Probert, Mrs. David
Puhs, Mrs. John A.
Rodenbaugh, Zilpah,
Stevenson, Sue
Thomas, Helen A.
Thomas, Mrs. O. E.
Westphal, Mrs. D. W.
Williams, Bertha
Williams, Emily
Williams, Evelyn
Williams, Mrs. Mary
Williamson, Edith E.
Wood, Mrs. John D.

The formal meeting was preceded by a very enjoyable concert by the Pittsburgh Glee Singers under the direction of Professor Maurice Lewis. Program rendered as follows:

PROGRAM

1. Chorus .... "The Viking Song"
2. Reading .... "Funny Family"

3. Baritone Song .... "Three For Jack"
4. Chorus .... "Sunset"
5. Soprano Group
   (a) "The Icicle"
6. Duet: Contralto and Soprano .... "Springtime"
7. Chorus .... "In This Hour of Softened Splendor"

PITTSBURGH GLEE SINGERS

Assisted by

Mrs. R. F. Gooding, Soprano   Miss Evelyn Williams, Soprano
Mrs. Gladys S. Dove, Contralto   Mr. ————, Tenor

Mr. Maurice Lewis, Baritone

DIRECTOR: Mr. Maurice Lewis

The call of the roll was dispensed with, as the record of attendance is given by the registration cards.

By common consent the reading of the minutes of the last meeting was dispensed with, as the printed Proceedings are already in the hands of the members.

The Secretary read the following list of proposals for membership:

Cromlish, A. L., General Superintendent, Carnegie Steel Company, Duquesne, Pa. Recommended by H. G. Huber.

George, R. H., Assistant Engineer, P. & L. E. R. R. Co., Room 506, P. & L. E. Terminal Building, Pittsburgh, Pa. Recommended by G. H. Burnette.

Jones, L. E., Assistant to Chief Civil Engineer, Carnegie Steel Company, 1012 Carnegie Building, Pittsburgh, Pa. Recommended by F. I. Snyder.

Krick, F. H., Train Master, Pan Handle Division, Pennsylvania Railroad, Room 612 Pennsylvania Station, Pittsburgh, Pa. Recommended by C. G. Grove.

Moyers, Samuel G., Representative, Mercury Manufacturing Company, 3103 Grant Building, Pittsburgh, Pa. Recommended by A. P. Schrader.

Newell, J. P., Jr., Supervisor Track, Pennsylvania Railroad, East Liberty Freight Station, Pittsburgh, Pa. Recommended by N. J. Allinger.

Thompson, Harry T., District Manager, Thermit Department,

Metal & Thermit Corporation, 1514 North Avenue, West, N. S., Pittsburgh, Pa. Recommended by E. A. Rauschart.

Wilson, James M., Metal & Thermit Corporation, 2961 Stafford Street, Corliss Station, Pittsburgh, Pa. Recommended by E. A. Rauschart.

PRESIDENT: In accordance with our By-laws these proposals will be referred to the Executive Committee and upon approval by that body, the gentlemen will become members without further action of the Club.

If there is no further business, we are now up to the paper of the evening. We are honored tonight by the presence of a New York Central official from New York City to address us. I am very much delighted to be able to ask one of his very dear friends to introduce him to you, Mr. J. B. Baker, Chief Engineer, Maintenance of Way Department, Pennsylvania Railroad.

MR. J. B. BAKER: Fellow Members of the Railway Club of Pittsburgh and invited Guests: Your President has conferred a very great honor and pleasure on me in asking me to present one whom I have considered for many, many years one of my very best friends and associates in the railroad business. However, your President, I think, took a slight advantage of me in that he made this suggestion between the eighteenth and the nineteenth hole of golf this afternoon, so that I am not prepared as to dates, except in a very general way, to give you a brief outline of the achievements of your speaker of the evening.

One of the greatest difficulties I am encountering is to be sufficiently brief to leave to your speaker opportunity to cover with you as much of his subject as time will allow, from his vast knowledge of railway maintenance. Therefore, I will give you very briefly what he has done within my knowledge in some of the positions which he has held.

In the first place he is a Pennsylvanian, having been born in Kittanning. He attended State College, and in 1900 took up the railroad business as his life work. He has been a member of the American Railway Engineering Association, Chairman of the Track Committee for some twelve years. Under his direction practically all the standards of switches, frogs and switch track fastenings have been decided and placed in the Manual of this Association. In 1930 he was elected Vice President of the

American Railway Association and in 1932 he was elected President of this the greatest of all the railway engineering associations in this country. Last year he was chosen by the management of the New York Central to represent that railroad at the International Congress held abroad and spent two months studying railroad practices with particular reference to maintenance of the railroads in France, Italy, Germany, Switzerland, Belgium and England. He may have touched a few others, but that is as far as I know.

In my judgment there is no better qualified man in this country to talk to you on maintenance of steam railways than your chief speaker tonight. He has a number of slides to show you, the only unfortunate thing being that we have not sufficient time to draw from him all he knows. However, I am quite positive that what he has time to tell us will be most interesting.

Perhaps in a way we are professional rivals, if I might aspire to that position of prominence. For all these years I have mentioned, these twelve years in the American Railway Engineering Association, we have exchanged confidences and worked together, and it is with very great pleasure that I present to you tonight Mr. J. V. Neubert, Chief Engineer, Maintenance of Way, New York Central Lines.

TRACK CONSTRUCTION AND ROADWAY MAINTENANCE

By J. V. NEUBERT, Chief Engineer Maintenance of Way, The New York Central Railroad Company, New York, N. Y.

Mr. President and Fellow Members of the Railway Club of Pittsburgh: After the very flattering introduction of Mr. Baker, I am afraid when it is all over you will find me in the situation of the tramp who wandered into a church during a revival meeting as a comfortable place to sit awhile. The subject of the minister did not interest him and the room was warm and the drone of the sermon soon put him to sleep. The minister reached an impassioned part of his sermon, and cried out: "All the members of my congregation who feel that they are going to heaven please stand up." There was a very generous number who stood up. "All the members of my congregation who feel that they are going the other way, stand up." The noise and the moving around disturbed the peaceful slum-

bers of the tramp, and as he looked up and saw the minister standing there and heard his loud command, he said: "I don't know what you are voting on, but it seems to me you and I are the only ones voting on this side." I am afraid that is where you may want me to land before I am through.

I was born in Pennsylvania and I am proud of it. I think it is one of the greatest privileges that I am invited here, especially by this Club, and I hope I may come within at least one-half of meeting the expectations that have been raised in your minds. I think you ought to just forget what Mr. Baker has said when you listen to what I may say. I am on a time schedule. I have some slides to show you afterwards, if you wish to see them, and if any of you wish to ask any questions you have got me here and I will answer to the best of my ability. I am scheduled out at eleven o'clock, and if that is not time enough I will cut the pin and stay longer, because this is your night, and your pleasure is my pleasure.

The first locomotive was made by a Frenchman, Nicholas J. Cougnot, in 1769, and was designed to run on the highway. It had two single-acting cylinders, with one front wheel and two rear wheels. It obtained a speed of three to four miles an hour and carried four people. Owing to its small boiler capacity, it would run from 12 to 15 minutes without stopping to get up steam.

Cougnot made several successful trials on the streets of Paris and while turning a corner one day at a speed of three miles an hour, the engine upset with a crash. From then on it was considered dangerous and was locked up in an Arsenal.

In 1784, William Murdoch, associated with James Watt, built the first locomotive to run on English soil. It obtained a speed of from six to eight miles an hour and also traveled the highway.

Richard Trevithick, of South Wales, was the first one in the world to introduce steam upon rails. In 1803 he won a wager by pulling several trucks with nine tons of iron between two designated points at a speed of five miles per hour.

Who built the first steam engine in the world? Ordinarily, credit goes to Cougnot and James Watt, but the Director of the Technical Museum of Stockholm, Sweden, has other ideas. He says that the first steam engine was built in 1728, eight years before the birth of James Watt, and its constructor was Maaron Triewald, a Swedish Professor of Astronomy. The Swedish Professor's steam engine is supposed to have been used for

several years at the mines in Dannemora in central Sweden, until lightning destroyed it in 1735.

Regarding the organization and working conditions of the earliest railroads, we have little or no knowledge, as history has not brought down these statistics to us. Therefore, maintenance costs at that time are not available for present comparison.

The average percentage of employees who constitute the Maintenance of Way Departments of various railroads, is as follows:

	Percent
Supervision	4.0
Bridge, Building and Track Foremen	11.0
Carpenters, Mechanics, etc.	15.0
Laborers	65.0
Miscellaneous	5.0
Total	100.0

The average operating expenses of the maintenance of way and structure block of railroads vary from 10½ to 12½ per cent of the earnings, depending upon local and maintenance requirements.

The proportion of labor and material used varies.

The average of 10 years, 1908-1917, was:

Labor	57.6%
Material	42.4%

The average of 10 years, 1918-1927, was:

Labor	59.0%
Material	41.0%

During the World War period in 1917, it was:

Labor	63.3%
Material	36.7%

That year, for the second time in the history of the railroads, they had a credit of approximately 3 per cent of total expenses for rail charges.

In 1918, Labor was	68.0%
Material	32.0%

The last of the normal years:

In 1929, Labor was	62.0%
Material	38.0%

During the two ensuing so-called abnormal years, it is interesting to note that:

In 1930,	Labor was	63.0%
	Material	37.0%
In 1931,	Labor was	62.0%
	Material	38.0%

or practically identical with the year 1929.

In the early days the roadbed was built on the lines of the highway, being designed to carry light carriages. Drainage was not considered to be a main element. Today, it has been widened and reinforced materially, and drainage improved, and is one of the main factors of proper maintenance.

One of the biggest steps taken in the development of railroad maintenance is in prolonging the life of cross ties and other material in wood preservation.

Statistics indicate that an untreated tie will last from eight to 12 years. In the early days when wood preservation was first considered, the American Railway Engineering Association felt that the maximum life we could expect to get from wood preservation or treatment, was 16 years. When the New York Central Lines considered the advisability of investing in the same, they figured that if they obtained 15 years average life they would get more than a fair return on the additional investment as compared with the untreated material.

To give one a fair comparison of what this represents of the total tracks of the New York Central Lines of approximately 27,000 miles, their installation in 1915 was 6,962,000 ties, or 282 ties to the mile, or an average life of approximately 10.9 years.

In 1931, after a period of 15 years, they installed 2,178,000 ties, or 87 ties to the mile, or an average life of approximately 21 years, or 4,783,500 more ties used in 1915 than in 1931, or 221 per cent greater.

The average of the 17-year period of installation was 4,458,500, or taking it on the ties per mile basis, we have 195 more ties used in 1915 than in 1931, or 224 per cent greater.

In 1915 the average per centage of treated ties in all tracks was 18 per cent, and in 1931 approximately 87 per cent.

Practically all ties, as well as switch timber, bridge piling and similar material, are treated with creosote, or a percentage of creosote and refined coal tar, averaging eight pounds per cubic foot, depending on the kind of timber treated. The bridge decking, planking and similar material, are treated with straight

creosote, averaging 10 pounds per cubic foot, or more, depending on the kind of timber to be treated.

Several years ago consideration was given to the pre-adzing and pre-boring of cross ties, and the first thought was that by doing this it would give a better and more thorough penetration through the area of the tie which receives the greatest mechanical wear, but one of the important factors it has accomplished by doing this, is that it affords the tie plate full and uniform bearing on the tie, and gives the rail a full and uniform bearing on the base, which gives the head area the same relative bearing as the base, which reduces distortion and unusual strains in the rail.

Ballast, in my estimation, has played a more important part in maintenance than I believe most of us realize.

The definition of "Sub-Ballast" is any material of a superior character which is spread on the finished sub-grade of the roadbed, and below the top ballast, to provide better drainage, prevent upheaval by frost, and better distribute the load over the roadbed.

"Ballast" is selected material placed on the roadbed for the purpose of holding the track to line and surface.

The various kinds of ballast used in the order of their importance are as follows:

(1) Stone, such as trap, lime and hard sandstone.

(2) Broken or crushed hard slag (a great many feel that this should come under Class 1 Ballast).

(3) Washed gravel.

(4) Screened gravel.

(5) Pit run gravel.

(6) Chats, which are tailings from zinc, lead, silver and other ore mines.

(7) Burnt clay or gumbo.

(8) Cinders.

Groups 1 to 4 inclusive could be bought under specifications. The others are accepted more or less as "pit run," or take them as they run from the natural deposit.

Before considering the application of ballast the roadbed section should be prepared to carry the cross-section of the ballast area, taking into full consideration the need of sufficient shoulder to protect the traffic, as well as the protection of the ballast section.

The roadbed should have sufficient drainage to allow surface and other waters to be carried off along the right-of-way and

be diverted from the roadbed area. In addition, it should permit the drainage from the ballast section to be carried off quickly.

Many railroad officials have contended that by an increase of from 10 to 30 pounds per yard in the weight of rail, they could overcome the inferiority of the present ballast conditions. I feel, however, that they will find it is more economical to apply preferred ballast, such as stone with a properly seasoned roadbed on a suitable sub-ballast, even though it were necessary to proceed on a slower rail installation program.

Great improvement has been made in the design and composition of rail in the last 10 to 15 years. Up to 1915 the maximum weight of rail per yard was 100 and 110 pounds. The prevailing weight used now in the United States is 110 and 130-pound sections, and there is also a considerable mileage of 90 and 100-pound. Of the heavier sections used within the radius of 130-pound R. E. section are the New York Central, 127-pound, 7 inches high, with 6¼-inch base; the P. S., 130-pound section, 6⅝ inches high, with 5½-inch base, which has been redesigned to the new 131-pound section, 7⅛ inches high, and a 6-inch base.

The Pennsylvania Railroad has also designed and rolled a P. S. section, 152-pound, 8 inches high, 6¾-inch base, of which, I believe, they installed approximately 6,000 tons in 1931.

The Lehigh Valley Railroad used from 1915 to 1931, 136-pound rail, 7 inches high, 6½-inch base, which in 1931 was redesigned with the same width base and weight, but 7⅜ inches high.

The open hearth rail began to come into use in 1908, and in the last several years practically all of the rail in the United States has been of open hearth.

One of the greatest problems that confronts us today in the investigation and research to eliminate broken and defective rails, is the interior transverse fissure type. I have been analyzing 8,000 miles of railroad, where I have known reports, and I find that rails of 80 pounds and up, for the years 1907 to 1912, the average failures per year within this limit, including broken and defective, were approximately 1,500. In the years 1923 to 1931, the average would be approximately 580, the former being in the Bessemer period, and the latter being in the Open Hearth period.

If this were set up in another way, it would give us ap-

proximately a failure of 0.28 per mile of track for the years 1907 to 1912, and for the years 1923 to 1931 it would give us a failure of 0.1 per mile of track. For the years 1916 to 1923, of the interior transverse fissure failures, there is an average of approximately 0.03 failures per mile of track, and for the years 1926 to 1931 approximately 0.06 per mile of track, so you can see from this analysis that the total failures in the Open Hearth rail have materially decreased, but the failures known as interior transverse fissures have materially increased.

We have operated, either by rental, or our own car over approximately 7,000 miles in the last two years, a Rail Detector Car, and from our inspections it develops that approximately 39 per cent of the rails detected were of the interior transverse fissure type, and 61 per cent covered split heads, crushed heads and other similar defects.

The rate of questionable rails to miles of track on the various divisions is variable, but the records accumulated on the New York Central Lines showed with the mileage tested that the cars had developed an average of one fissure rail in every 19 miles of track; an average for the split heads, crushed heads and other similar defects of one in every 10 miles, and for all defects, one in seven miles of track.

During my visit to Europe in May, 1930, in connection with attending the International Railway Congress at Madrid, Spain, I traveled wholly or in part through the following countries: France, Spain, Italy, Switzerland, Germany, Belgium and England, covering 6,000 miles, the major part of my journey being by rail.

The equipment does not in any way compare with that used in the United States. The maximum axle load for their locomotives is about 17 tons and this is now being increased in some of the countries to approximately 22 tons.

Their carriages are classified as first, second and third class, the first class, somewhat similar to our Pullman, chair and sleeping cars, are much lighter and considerably shorter than the cars used for similar service here. The majority of them have a single axle at each end. A few of the third class carriages, however, have three axles, one at each end and one in the middle. These carriages carry, on the average, from 18 to 30 people.

The speed of their passenger trains on certain runs, with less stops per distance, is much higher than here. However, as a whole, their speed is not comparable to the speeds in the

United States, considering our longer trains and greater tonnage.

Their freight equipment is unusually light, having a single axle truck on each end, similar to their passenger carriages or coaches. A few of the countries, particularly Switzerland and Germany, are starting to use the four-wheel truck with longer cars, and carrying heavier loads. The average weight per car is approximately 15 tons. I doubt if the maximum would run over 20 tons. In fact, one could get a very good idea of the weight, as they use turn-tables for turning cars in a great many of their yards and terminals for platform or team yard loading and unloading, two men easily turning the table by hand, with cars either loaded or empty. The freight runs are short and the nature of their commodities is such that there is no effect from brine to cause corrosion. In some countries, particularly in France and Spain, they still rely on the hand brake for stopping and controlling the train.

The gauge of the track in all these countries is about 4 feet 8½ inches, with the exception of Spain, where their gauge is 5 feet 3 inches. Their gauge seems to be well maintained. In fact, should be, with their heavy fastening of the rail to the tie and tie plate.

Their general maintenance program from my observation, is entirely different from that in the United States. For example, they estimate the average life of the entire track structure and the life of the rail is based on this average. A schedule is then set up as to the amount of rail to be renewed and the entire track structure, rail, ties and fastenings are taken out, the roadbed smoothed down and new material put in its place. The mileage set up for renewal depends upon their new rail schedule and the general conditions of the territory on which it is to be installed.

When this work is being performed, traffic is run around or detoured, so that they can get the full and absolute use of replacing or restoring the roadbed and track.

Most of the railroads in Europe, I found, were of two or more main tracks and this made it of great advantage in detouring trains.

Great stress seems to be made in all the countries in regard to the alignment of curves. They operate as a whole, a little faster over the same degree of curvature than we do in the United States, and, in my estimation, with ease and com-

fort, and this, I believe, is entirely due to an established uniform grade, meaning no sags throughout the length of the curve and a short distance beyond on to the tangent, with uniform alignment.

As a whole, I feel that the railroads in the United States are comparable, if not better in their maintenance conditions, than the European railroads.

Conditions in roadway construction, motive power and rolling stock, which obtained during the first decade, or even later, have left their impress down to the present day. Up to a few years ago, British railway coaches bore the external panels of an old-fashioned stage coach, and the present form of American railway truck does not now, after 60 years' constant experience, differ in any essential particulars from that of some prototypes. Original construction included a roadbed built in much the same manner as today, with wooden ties or sleepers, rails, ballast and other material, but all of these have been improved from time to time to meet the service and conditions. Possibly some may think that the Maintenance of Way Department is not keeping in line with progress and other details of railroading. I assure you, I feel that the Maintenance of Way Department has done its full duty in revising and strengthening the roadbed, providing drainage, increasing the rail sections, laying larger ties, using tie plates, more substantial ballast, and special appliances to help maintain a smooth and comfortable riding roadbed at any speed.

We have better and smoother riding track today than we have ever had, with fewer derailments. I have made an analysis of the causes of 40,000 derailments, with this result:

Operation	48.6%
Equipment	35.4%
Unavoidable	11.0%
Maintenance of Way	5.0%

Of the derailments charged against the Maintenance of Way Department, very few were attributed to main line conditions. A large percentage of them were due to maintenance of private side tracks.

What is the future of the railroads? One reads much, but transportation and sheer stick-to-i-tiveness have been the backbone of our country for 100 years or more. The regulation of transportation such as air, water, highway, pipe lines and rail must come on a fair and equitable rate or tariff, established with equal regulation, or similar to what the railroads are now

confronted with. It is true that the railroads for the past few years have been living through what is called the "mechanical age," and what further developments will be made, time alone will tell. I believe, however, if some of the equipment that we are using would be set up with its initial cost, interest on the investment, depreciation, etc., for its year's performance, considering the short period that some of the equipment is used, I doubt if some of the equipment is giving us the total average return per year that we expect. I feel that when conditions get back to normal, some change in equipment will be made, depending upon operating conditions, and a great deal of our material and other supplies will be handled with equipment, which will not interfere with train operation.

I feel that the railroads in this country, especially in the Maintenance of Way Department, could be helped materially if an allowance or budget could be set up whereby they could have the allowance for three or possibly four months at a time, especially from April 1 to November 30 of each year. It would allow them to set up a more constant force and spread their expenses. Most of the railroads accrue their tie and rail charges, and some ballast, meaning that they charge off each month one-twelfth of their estimated set-up for the year. If Account 216, "Other Track Material," were included in the accruals, it would help, in my estimation, materially, and it would allow anyone to lay rail at any time to suit their conditions best, and not materially affect their expenses during certain months, which it sometimes has. As an example, 1918-1927, the rail charges were 6 per cent of the total M. W. & S. block. In 1930, the rail charges were 6 per cent; in 1931 they were 8.1 per cent. The "Other Track Material" was 7.3 per cent in 1930, and in 1931 was 7.4 per cent.

In traveling over the road to observe conditions I find that the things most neglected are the proper instructions to foremen, and the improper use of tools and material. There is an old saying, particularly in the United States: "In America we waste material to conserve labor, on account of the rate, and in Europe they waste the labor to conserve material." The recent depression has taught us we have to analyze these conditions, and conserve both.

I feel that Supervisors and others are transmitting too many orders by letter. A word spoken from the mouth is worth more than twenty on paper. The majority of the foremen who are doing work wrong, in my estimation, have not

been properly instructed. Personal contact, I believe, will tend to improve relations, as well as improving the efficient use of labor and material, thus reducing expenses and raising the morale. I believe that a number of the supervising class could improve conditions by having a little more tact in this respect, and also by seeing that their men have the proper tools and material for the work assigned. When foremen want help, see that they get it. Confer with them more often and weigh their suggestions. An official of an eastern railroad once said: "A five-minute talk is worth more than 30 days' suspension, and in the end will pay a larger dividend for the company," and I feel that by working along the lines I have indicated you will help the management to improve conditions and promote economical operation.

One says: "Knowledge comes from the outside; understanding comes from within."

The late Senator Chauncey M. Depew said that "the railroad is a field to which one's life can be devoted with a feeling that no matter how small a part one may play, that part is of vital importance to the life of the nation."

What we need to solve the railroad condition today is more traffic. It is the time of the year we think and look for the singing of the birds, and the flowers that bloom in the spring, but what we need most today is a slogan of "The smoke goes up the chimney just the same." That will revive commerce and industry, and transportation will move down the right-of-way of happiness again. In fact, all of us feel that the work or vocation we have chosen or have been following for a number of years has been wrong, and that same thing has applied to people who have chosen the vocation of the earliest days, namely, "The Farmer." Comparing his condition to ours, I read you as follows:

"FARMER'S LIFE"

Down on the farm, 'bout half past four,
I slip on my pants and sneak out of the door;
Out of the yard I run like the dickens
To milk ten cows and feed the chickens,
Clean out the barn, curry Nancy and Jiggs,
Separate the cream and slop all the pigs,
Work two hours, then eat like a Turk,
And, by heck, I'm ready for a full day's work.

Then I grease the wagon and put on the rack,
Throw a jug of water in an old grain sack,
Hitch up the horses, hustle down the lane,
Must get the hay in, for it looks like rain,
Look over yonder! Sure as I'm born,
Cattle on the rampage and cows in the corn;
Start across the medder, run a mile or two,
Heaving like I'm wind-broke, get wet clear through,
Get back to the horses, then for recompense
Nancy gets straddle the barbed-wire fence,
Joints all a-aching and muscles in a jerk,
I'm fit as a fiddle for a full day's work.

Work all summer 'till winter is nigh,
Then figure up the books and heave a big sigh,
Worked all year, didn't make a thing;
Got less cash now than I had last spring.
Now, some people tell us that there ain't no hell,
But they never farmed, so they can't tell.
When spring rolls 'round I take another chance,
While the fringe grows longer on my old gray pants,
Give my s'penders a hitch, my belt another jerk,
And, by heck, I'm ready for a full year's work.

Following the speaker's address a large number of pictures were illustrated on the screen, a few of which are shown herewith.

PRESIDENT: We have heard a very interesting speaker on a very interesting subject. It is a little late, but we are going to give you a little time while the waiters are preparing the usual lunch for any questions you may desire to ask. Before doing so, however, we have with us one of the oldest track walkers and section men on the P. & L. E., who has been general foreman of track longer than any other man in the room. He may not want to talk, because he never will speak in public, but I would like to have Tim Hartnett stand up.

(Mr. Hartnett was greeted with vigorous applause.)

I do not think I should be required to call on any one. We have a splendid attendance and a large number of visitors, and I hope the visitors will find the evening of sufficient interest to give them the wish to join the Club. Dr. John S. Unger,

of the Carnegie Steel Company, is here and I will ask him to open the discussion.

DR. JOHN S. UNGER: Mr. Chairman and Gentleman:—We have listened to a very excellent address by Mr. Neubert. We are all very much interested in what he had to say.

Mr. Neubert says the principal cause of rail failures is

Double Split Head. L. S. Co., 1909, Heat #3592, 80#-5⅛" Rail. Removed from North Bound Track 3 Miles South of Geneva Station, March 12 ,1912. Covered by MW-7 Report #77.

transverse fissures. Out of a list of 1,200 rail failures on a certain railroad, only 70 of the 1,200 could be traced to transverse fissures. The rest of them were failures of other kinds. Mr. Neubert knows that the question of transverse fissures as a cause of rail failures is being investigated very carefully by a joint committee composed of prominent railroad officials of the United States and all the rail makers in the United States, who have been giving close attention to this problem at the University of Illinois for more than a year, making a study of what causes rail failures, particularly transverse fissures. Up to the present time they have not reached any definite conclusions.

The rail situation is peculiar. At a meeting in Chicago last March of a joint committee composed of railroad men and manufacturers, among other things they were discussing was a reduction in the chemical hardness of the rail. Several members believed the rail was chemically too hard and was not ductile enough. My reaction after the meeting was over was that there would be a modification of the chemical hardness of the rail in future specifications.

Another thing that seems strange and contradictory is that some people would like to make the rail harder. They forget that if you make the rail harder you have to sacrifice some ductility. It is like a lever having arms of equal length. If you place a weight at one end you tip the other end up. The same is true in manufacturing steel. You may increase its ability to resist wear by making it harder, but you will go to the other extreme and make it so hard it does not possess enough ductility to function as a whole. A hard rail will show decreased wear but a rail of that character is likely to fail through some cause or another much earlier than the more ductile rail. The service demanded of the rail today is very much greater than that demanded in the past. There was a time when the average wheel load was approximately 15,000 pounds, then 20,000 and 25,000, and today it is more than 35,000 pounds. The average contact between the wheel and rail is about ⅝″ in diameter, about the size of a dime.

MR. NEUBERT: Three-eighths.

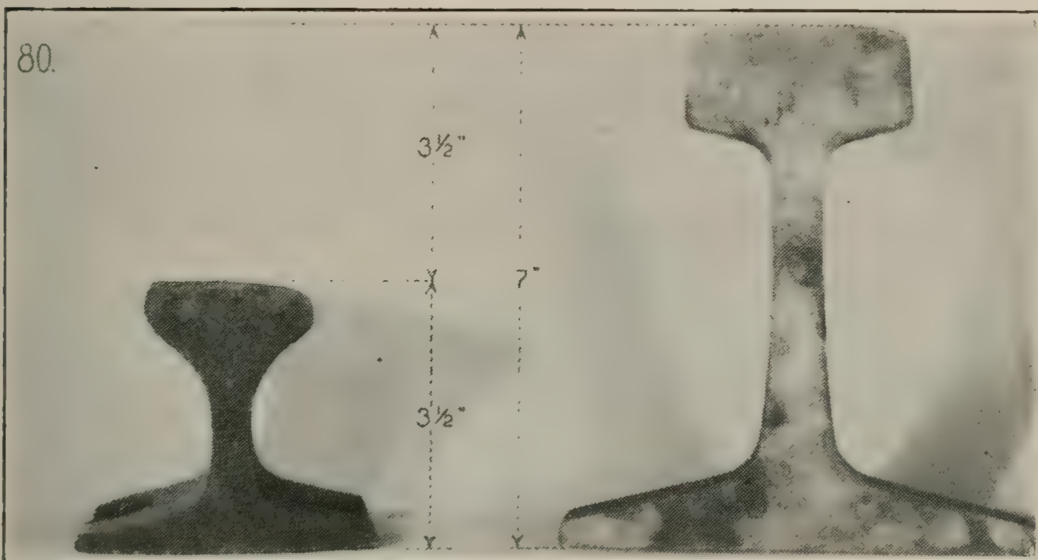
DR. UNGER: I insist on ⅝″, but we will compromise on ½″. That is greater than the elastic limit of that steel at the surface of the rail. The steel is bound to flow and as the wheel moves along the rail back and forth the material in the rail is pushed in one direction and then in the other direction until the material at the surface is fatigued and peels off. As you walk along the track you can see little parts of the metal like mica lying on the ties. It has been stated that railroads in order to pay their way have to haul heavier loads. That is true.

I see a number of my railroad friends in the audience smiling at me and I think it is time for me to stop, because I know I am going to hear about this later. The rail maker and the rail user are doing all they can at the present time to improve the quality of the rail. I do not believe we can ever get together because as soon as we approach it the demands will

increase. They have increased in the past and I believe we can use the past as an indication of the history of the future.

PRESIDENT: Mr. C. B. Bronson, Assistant Inspecting Engineer, New York Central Lines, may we hear from you?

MR. C. B. BRONSON: Mr. Chairman, Members of the Railway Club of Pittsburgh, and Guests: The inspiring address



40 lbs. per Yd. In Service, 1855. Height, 3½". Weight, 40#. Process, Wrought Iron.

127 lbs. per Yd. In Service, 1925. Height, 7". Weight, 127#. Process, Open Hearth.

of Mr. Neubert, the fine music which was rendered, and the welcome which we are receiving from this progressive Club, act as an incentive to join in this interesting discussion. Dr. Unger has just brought up an important subject, and I am heartily in favor of the views which he expressed. That is to reduce the upper carbon limit for heavy steel rails to about 0.80 per cent. I am certain that there will be no sacrifice in wearing qualities and at the same time obtain a steel of greater average toughness. In the case of the New York Central Lines, we are unique amongst rail users in that all of our sections from 100 to 127 pounds inclusive have identical chemical requirements, with an upper limit in carbon of 0.75 per cent. Yet we obtain the same or equal hardness, and even greater penetrative effect from the pressure in rolling the rails than for all of the heavier sections in use, due to the fact that we have a broad thin head rather than one of greater depth and lesser width. We are obtaining remarkable wearing qualities and a fine illustration of this is some work we were doing only today

on the Pittsburgh & Lake Erie where we found an average wear of 3/32 inch from the top of the rail head in eleven years on a double track line which carries in normal times a large volume of both freight and passenger business.

I know from personal experience that Dr. Unger is decidedly in favor of our general policy as to chemical specifications for rails, and also agrees that with our lower carbon limits, and the adjustment we make in manganese with the range from 0.70 to 1.00 per cent that we have a well balanced composition, coupled with our type of rail design, to give toughness and wearing qualities to the metal. Our average carbon from studies of thousands of heats is 0.69 and the manganese average is close to 0.83. We are aiming to avoid brittleness and have the maximum degree of safety in rail steel.

Hamm, Germany, June 3, 1930. Crane for Picking Up Sections of Track.

Mr. Neubert has presented information and also shown you slides of that wonderful device—the DETECTOR CAR. We have our own car which is carefully and laboriously testing our tracks from New York to Chicago, and all other main line tracks at a speed of five miles per hour. It requires about two and one-half months to cover the two high speed tracks between New York and Chicago. The purpose of the car is to eliminate all defective rails from the track. And the car is doing this with absolute certainty. We owe a debt of gratitude to the late Dr. E. A. Sperry for his invention and development of this marvellous device. The electrical method employed is simple in principle, though complicated in application. The New York Central Lines purchased a car for their exclusive

use, which is making an enviable record in detection of defective rails, thus increasing the safety of travel and transportation.

PRESIDENT: Mr. A. C. Clark, Assistant Chief Engineer, B. & O. R. R. We would like a word from him.

MR. A. C. CLARK: I have nothing to add that would be of interest. I am glad to be here and listen to this most interesting paper.

PRESIDENT: Mr. F. R. Layng, Chief Engineer, B. & L. E.

MR. F. R. LAYNG: I have enjoyed this meeting very much. I am one of your baby members and I feel that it is a very great privilege. I have known Mr. Neubert for a great many years and I have great confidence in his ability and I think we are really indebted to him for his talk this evening.

PRESIDENT: We have a visitor here tonight that I know has not been in the Club before. We are glad to have him here and I hope he can find it possible to come to our meetings oftener, Mr. W. E. Fowler, Vice President and General Manager, Pittsburgh, Lisbon & Western Railroad.

MR. W. E. FOWLER: I do not think I have anything to add. When I saw that this evening's program had to do with maintenance I was very much interested, and I have not been disappointed. I think you are wrong, however, in saying that I was never here before. In fact I was a member until about two years ago, and now that I am within reach again I am going to turn in another application for membership.

PRESIDENT: Thank you very much. The Secretary informed me of your predicament.

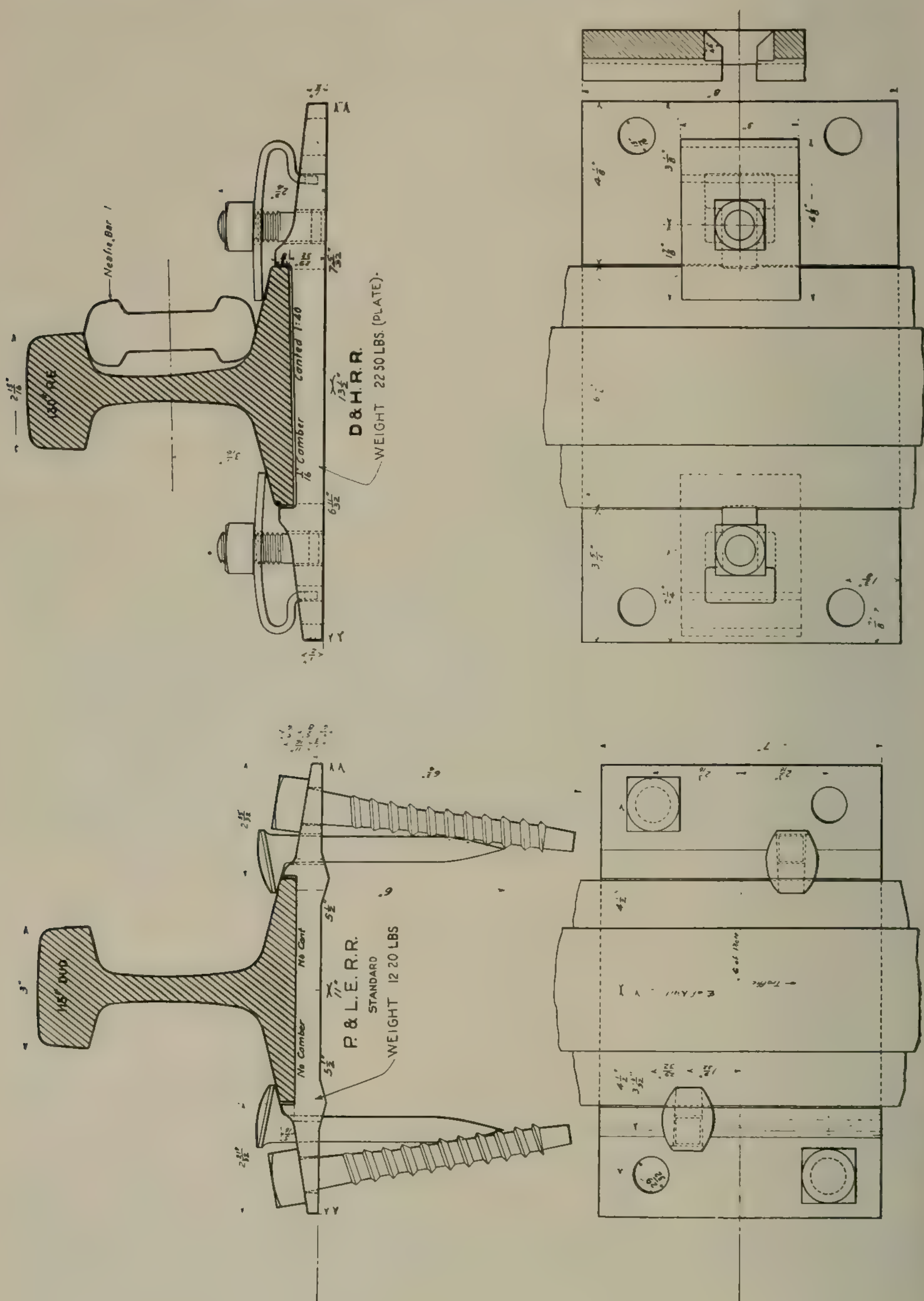
Mr. Jones, Assistant Chief Engineer, Carnegie Steel Co., we would be glad to hear from you.

MR. L. E. JONES: I also was a member of the Club several years ago and like Mr. Fowler, being in Pittsburgh I am going to put in an application and come back.

PRESIDENT: Anybody else?

MR. J. B. BAKER: I would like to call to the minds of a number of men in the Railway Club and for the benefit of

some who do not know, the fact that one of these Sperry test cars was exhibited in the Pennsylvania Station about a year ago. It was about Christmas time and a great many men interested in that phase of development availed themselves of

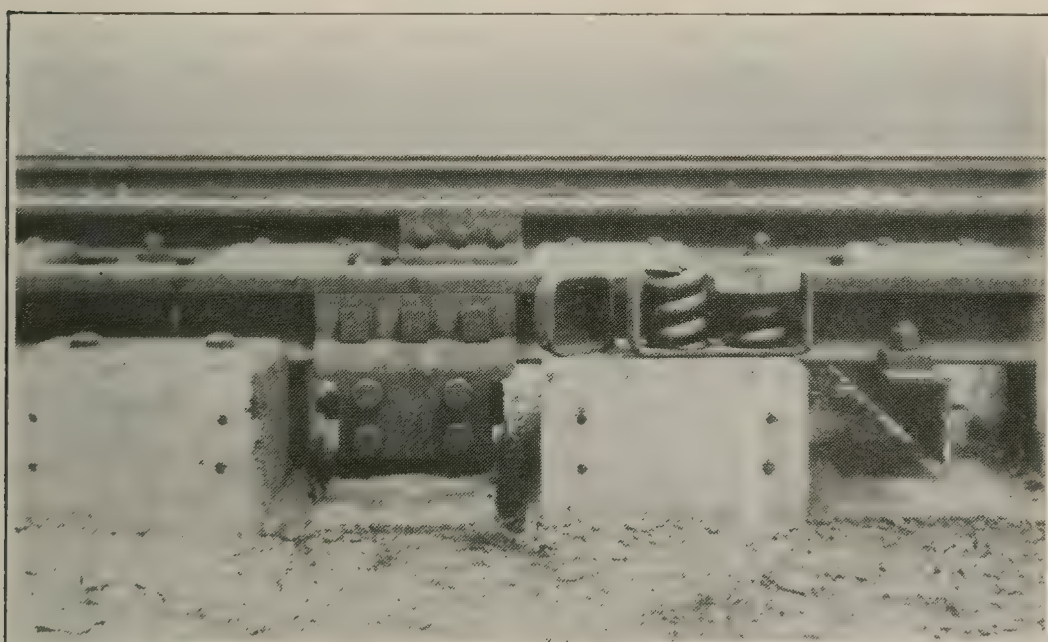


the opportunity to look over the car and learn the details of its operation. That car is now again on the Pittsburgh Division, running between here and Altoona, and I am wondering

if you would like to ask an expression of opinion as to whether or not there is sufficient interest to warrant us in placing that car in the Station for inspection of those who might not have been very familiar with the work at the time it was here some year and a half ago. If there is sufficient interest we might be able to arrange to leave it here over a 24-hour period.

Now the question I would like to ask the speaker of the evening, referring to pre-boring and pre-adzing of ties. In your opinion is it good practice to apply tie plates at the time of pre-adzing and boring, or to put the plates on in the field?

MR. NEUBERT: I would apply screw spike tie plates in advance, or at the Treating Plant, but for the cut spikes, as the ties are applied. In Germany, at one of their plants, they



"Wirth" Experimental Permanent Track Showing Springs Built October, 1928. Austrian R'ys. Type 1.

were applying screw spike construction to the tie before they shipped it to the right-of-way, and they seemed to get it mathematically located and more securely fastened to the tie.

In regard to single and double-shoulder tie plate especially for screw spike construction: I feel that the shoulder for either one should be ½″ high on account of getting the benefit of it throughout the life of the tie plate on account of the rapid corrosion of the metals and the track fastenings. It is a question whether the double-shoulder tie plate gives us full advantage as intended, as from the information I have, approximately

30-40% of the bearing of the base of the rail is on the inside of the shoulder of the plate.

MR. R. P. FORSBERG: Mr. Neubert, in the slides you have just shown on the screen illustrating some phases of European railway practice you spoke of the rails as being 15, 20 and I believe 25 meters in length. When I get to my office in the morning and have access to a pencil and some paper I am going to figure out the lengths of those rails and determine what they are in United States language.

In the meantime will you tell us some of the factors that determine our present length of rails, namely 33 feet and 39 feet and why should we not roll them longer?

MR. NEUBERT: The length of rails in the United States is now standard at 39 ft. long. This was established on account of the prevailing length of cars whereby they could be handled one length on an individual car. However, longer rails are used for trial, such as some 45 ft., 60 ft. and 66 ft. In Europe the prevailing length runs from about 46-50 ft., and in some cases, particularly Germany, the 30 metre, or 100 ft.

The present disadvantages in the United States in going to a longer rail, namely, in the neighborhood of 60 ft., are as follows:

First—On account of the force and inconvenience for application and reapplication.

Second—With the number of failures of all causes that we have today, if we would have to take out a broken rail, we would have to scrap today a 39 ft. rail, whereas we would have to scrap one 60 ft. or longer, in that vicinity.

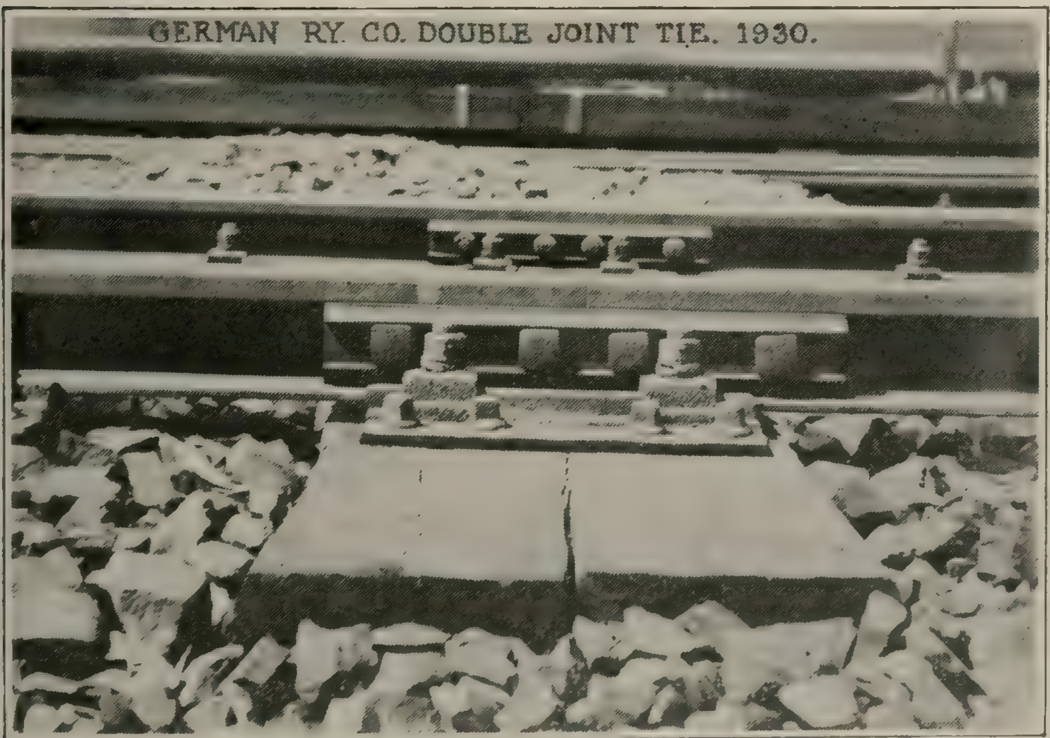
As soon as rail failures are considered I think the longer rail will be looked upon more favorably. I do not feel that the extension will be of any unusual hardship because that same matter was considered when we had the rail 30 ft. long and extended it into the 33 ft. and 39 ft.

PRESIDENT: Gentlemen, you have heard the offer made by Mr. Baker, Chief Engineer of Maintenance of the Pennsylvania, with reference to the Sperry car. I would like to have you hold up your hand if you are interested in having the car stop off at Pittsburgh to afford you an opportunity to see it.

(Many hands responded favorably).

Mr. Baker I think will make arrangement to stop the car 24 hours in Pittsburgh, in response to this request.

We have another gentleman here from the P. & L. E., Mr. Con. Hartnett. He is very much disgusted with this program because the speaker did not show any pictures of the railroads in Ireland. Mr. Hartnett, will you stand up so we can see you.



The lunch is now ready and we have had a very interesting meeting and I would like to call on the First Vice President for a few words before we adjourn.

MR. F. I. SNYDER: Mr. President, we have had a very interesting talk and I am sure we are all very grateful to the speaker for it. He has come some distance and taken time out of his busy affairs to be with us and we appreciate it. I would move that a rising vote of thanks be extended to Mr. Neubert in expression of our appreciation.

The motion prevailed by unanimous rising vote.

PRESIDENT: If there is no further business we will now stand adjourned.

J. D. CONWAY, Secretary.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of Official Proceedings—Railway Club of Pittsburgh, published Monthly, except June, July and August, at Pittsburgh, Pa., for April 1, 1932.

STATE OF PENNSYLVANIA }
COUNTY OF ALLEGHENY } ss:

Before me, a Notary Public in and for the State and county aforesaid, personally appeared J. D. Conway, Secretary, who having been duly sworn according to law, deposes and says that he is the Editor and Publisher, of the Official Proceedings—Railway Club of Pittsburgh.

Publisher Official Proceedings—Railway Club of Pittsburgh.

Editor, J. D. Conway, 515 Grandview Avenue, Pittsburgh, Pa., (19th Ward.)

Managing Editor, J. D. Conway, 515 Grandview Avenue, Pittsburgh, Pa., (19th Ward.)

Business Manager, J. D. Conway, 515 Grandview Avenue, Pittsburgh, Pa., (19th Ward.)

The Official Proceedings—The Railway Club of Pittsburgh.

President, J. E. Hughes, Pittsburgh, Pa.

Vice President, F. I. Snyder, Pittsburgh, Pa.

Secretary, J. D. Conway, Pittsburgh, Pa.

Treasurer, E. J. Searles, Pittsburgh, Pa.

Known Bondholders—None.

J. D. CONWAY.

Sworn to and subscribed before me this 24th day of March, 1932.

(Seal) AGNES B. SHAW, Notary Public.
(My commission expires March 9, 1935.)

RESERVED

OFFICIAL PROCEEDINGS

RAILWAY CLUB OF PITTSBURGH

\$1.00 Per Year 25¢ Per Copy

Vol. XXXI. MAY 26, 1932. No. 7.

The Manufacture of Commercial Aluminum and Aluminum Alloys

By DR. PAUL V. FARAGHER,

Some Applications of Aluminum Alloys in the Transportation Field

By A. H. WOOLLEN, Engineer, Development Division,

Building a Concrete Dam "On End" and Blasting It Into Position

By JAMES W. RICKEY, Chief Hydraulic Engineer,

Aluminum Company of America

OFFICIAL PROCEEDINGS

OF

The Railway Club of Pittsburgh

Organized October 18, 1901

Published monthly, except June, July and August, by the Railway Club of Pittsburgh, J. D. Conway, Secretary, 515 Grandview Ave., Pittsburgh, Pa.

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Pittsburgh, Pa., May 26, 1932

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*H. W. WATTS	November, 1907, to April, 1908
*D. J. REDDING	November, 1908, to October, 1910
*F. R. McFEATTERS	November, 1910, to October, 1912
†A. G. MITCHELL	November, 1912, to October, 1914
*F. M. McNULTY	November, 1914, to October, 1916
J. G. CODE	November, 1916, to October, 1917
*D. M. HOWE	November, 1917, to October, 1918
*J. A. SPIELMANN	November, 1918, to October, 1919
H. H. MAXFIELD	November, 1919, to October, 1920
FRANK J. LANAHAN	November, 1920, to October, 1921
SAMUEL LYNN	November, 1921, to October, 1922
D. F. CRAWFORD	November, 1922, to October, 1923
GEO. D. OGDEN	November, 1923, to October, 1924
A. STUCKI	November, 1924, to October, 1925
F. G. MINNICK	November, 1925, to October, 1926
G. W. WILDIN	November, 1926, to October, 1927
E. J. DEVANS	November, 1927, to October, 1928
W. S. McABEE	November, 1928, to October, 1929
E. W. SMITH	November, 1929, to October, 1930
LOUIS E. ENDSLEY	November, 1930, to October, 1931

*—Deceased.
†—Resigned.

Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING

MAY 26, 1932

The regular monthly meeting was called to order at the Fort Pitt Hotel at 8 o'clock, P. M., with President J. E. Hughes in the chair.

There were 190 registered in attendance, as follows:

MEMBERS

Allen, Harvey
Altsman, W. H.
Ambrose, W. F.
Ashton, William A.
Bair, J. K.
Bald, E. J.
Balzer, C. E.
Beam, E. J.
Berg, Karl
Bonhoff, E. L.
Buffington, W. P.
Bull, R. S.
Burnette, G. H.
Campbell, J. E.
Carlson, L. E.
Christy, F. X.
Conway, J. D.
Coombe, A. B.
Courtney, H.
Dalzell, W. E.
Dambach, C. O.
Davies, James
Davis, Charles S.
Emery, E.
Emsheimer, Louis
En Dean, J. F.
Endsley, Prof. Louis E.
Evans, David F.
Flinn, R. H.
Freshwater, F. H.
Furch, G. J.
Gardner, George R.
Gatfield, Phillip
George, R. H.
Glenn, J. H.
Hansen, William C.
Henderson, George L.
Hepburn, P. W.
Hilstrom, A. V.
Holmes, E. H.
Hoover, J. W.
Hughes, John E.
Johnston, W. A.
Kaup, H. E.
Keller, R. E.
Knapp, A. D.
Kraus, Raymond E.
Krick, F. H.
Kruse, J. F. W.
Kummer, Joseph H.
Lanahan, Frank J.
Landis, William C.
Laughner, C. L.
Laurent, Joseph A.
Layng, F. R.
Lee, L. A.
Loeffler, George O.
Lunden, Carl J.
Lynn, Samuel
Masterman, T. W.
Mertz, G. H.
Millar, C. W.
Miller, J.
Misner, George W.
Mitchell, F. K.
Mitchell, W. S.
Moore, D. O.
Morgan, A. L.
Morgan, Homer C.
McHugh, C. A.
McIntyre, R. C.
McKinley, John T.
Paisley, F. R.
Palmer, E. A.
Passmore, H. E.
Pringle, H. C.
Pugh, A. J.
Redding, P. E.
Rumbarger, F. A.
Ryan, Frank J.

Schmitt, Raymond F.
Seiss, W. C.
Severn, A. B.
Sharp, H. W.
Sheets, H. E.
Sheridan, Thomas F.
Sinclair, I. B.
Smith, J. Frank
Snyder, F. I.
Stamm, Bruce B.
Stevens, R. R.
Stucki, A.
Sutherland, Lloyd
Thomas, T. T.
Thompson, Harry T.
Thornton, A. W.
Van Blarcom, W. C.
Walther, G. C.
Welch, E. M.
Whalen, D. J.
Wheeler, C. M.
Wildin, G. W.
Wilson, J. M.
Winslow, S. H.
Woodward, R.
Wurts, T. C.
Yarnall, Jesse C.
Young, F. C.
Zammikeil, John

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Bartlet, G.
Bartlic, D.
Berbach, L. J.
Bleifuss, D. J.
Bossert, T. W.
Brickner, H. E.
Campbell, G. F.
Carruthers, G. R.
Chesley, J. O.
Crill, F. E.
Curcio, Harry
DeArmit, W. P.
Dunham, C. W.
Ewald, Robert F.
Faragher, Dr. P. V.
Fahrney, H. T.
Fischer, G. M.
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Fowler, W. E., Jr.
Furch, George J., Jr.
Gabosh, Elmer J.
Germerodt, H. E.
Goll, Frank D.
Goodwin, A. E.
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Gumbert, D. W.
Hall, J. C.
Hastings, C. M.
Heckmon, C. J.
Henry, Lewis W.
Herley, J. E.
Hilf, J. H.
Horen, B. H.
Hunt, Roy A.
Jeffries, Ernest
Johnson, H. F.
Judge, A. L.
Kaltenbach, Herbert
Kaup, Earle W.
Kenney, C. P.
Kernan, C. J.
Keys, R. H.
Kidd, Professor H. C.
Kurt, Clarence C.
Lewis, S. B.
Mahrer, D.
Marsh, Kirtland
Mates, J. W.
Mitchell, Paul L.
Monroe, R. A.
McCoy, W. J.
McDonald, R. A.
McFadden, B. C.
McGeary, E. J.
McKee, Robert B.
Noyes, M. E.
Parks, R. E.
Pennoyer, R. P.
Preston, Charles A.
Reding, H. W.
Reithel, Benjamin H.
Reynolds A. C.
Richardson, E. T.
Rickey, James W.

Rodee, H. H.	Surdoral, L. A.
Ross, A. C.	Tepel, J. A.
Scott, W. A.	Thatcher, A. J.
Shivus, W. H.	Tripp, W. N.
Smith, Sion B.	Woollen, A. H.
Smith, W. H.	Woollen, F. L.

Young, R. O.

The call of the roll was dispensed with as the record of attendance is given on the registration cards.

By common consent the reading of the minutes was dispensed with as the printed Proceedings have already been distributed.

The Secretary read the following proposals for membership:

Campbell, G. F., Division Freight Agent, P. & L. E. R. R., Union National Bank Building, Youngstown, Ohio. Recommended by J. E. Hughes.

Fowler, W. E., Vice-President and General Manager, Pittsburgh, Lisbon & Western Railroad, 21 East Front Street, Youngstown, Ohio. Recommended by E. A. Rauschart.

Rankin, Roy S., District Representative, Hachmeister-Lind Company, R. D. No. 2, Coraopolis Heights, Coraopolis, Pa. Recommended by E. A. Rauschart.

Woollen, A. H., Engineer, Development Division, Aluminum Company of America, New Kensington, Pa. Recommended by James Davies.

PRESIDENT: In accordance with our By-laws, these names will be referred to the Executive Committee, and upon approval by that Committee the gentlemen will become members without further action of the Club.

The Secretary announced that information had been received since the last meeting of the death of A. P. Weston, Manager Inspection Department, Pittsburgh Testing Laboratory, Pittsburgh, Pa., which occurred on April 26, 1932, and Gilbert E. Ryder, Vice-President, The Superheater Company, New York, N. Y., who passed away on May 17, 1932.

PRESIDENT: An appropriate memorial minute will appear in the next issue of the Proceedings.

Is there any other business that should come before the meeting at this time? If not, we come to the papers of the evening, on a subject of especial interest to all of us.

The first paper is on the Manufacture of Commercial Aluminum and its Alloys, and I am privileged to present to you Dr. Paul V. Faragher who will discuss that subject.

The Manufacture of Commercial Aluminum and Aluminum Alloys

By DR. PAUL V. FARAGHER,
Aluminum Company of America, Pittsburgh, Pa.

Mr. President, members of the Railway Club of Pittsburgh and guests, the purpose of this talk is to give you a picture of the development of the aluminum industry and to describe briefly the origin of the metal, its method of manufacture and the properties of the metal upon which its use in industry is based.

Aluminum occurs in the earth's crust in practically twice the percentage that iron is present. Clay, shale and many of the rocks contain considerable percentages of aluminum. These minerals are not used at the present time in the production of the metal since it is more economical to start with a naturally occurring mineral called bauxite which is made up of aluminum hydroxide contaminated with more or less iron oxide, silica, etc., as impurities.

It is not possible to reduce the oxide of aluminum by means of coke or other chemical reducing agents because the metal retains the oxygen more tenaciously than do the ordinary reducing agents. The metal was, therefore, first produced by means of a complicated chemical reaction making use of metallic potassium and aluminum chloride. This process formed the basis of the commercial method of production with the substitution of metallic sodium for potassium, until the discovery of the electrolytic process by Charles M. Hall in 1886. It was this latter discovery which has made possible the aluminum industry as we know it today.

The first step in the production of the metal consists in the purification of the bauxite. In contrast with the metallurgy of most other common metals, it is more economical to purify the ingredients which go into the process and manufacture of aluminum in the pure condition than it is to produce impure metal and later refine it to the desired purity.

In order to separate the aluminum oxide contained in the bauxite from the impurities with which it is associated, the

bauxite is treated at elevated temperatures with a solution of caustic soda. Under these conditions of temperature and pressure, the aluminum oxide combines to form soluble sodium aluminate which is filtered off from the impurities, which are not dissolved by the caustic solution.

This sodium aluminate solution is then allowed to cool in the presence of crystals of aluminum hydroxide which have been formed in a previous cycle of the process. As the solution cools, the aluminum hydroxide is precipitated from the solution. It is then washed to remove the caustic soda and is finally heated to a high temperature to drive off the chemically combined water and form aluminum oxide of a high degree of purity. This heating also changes the crystal form of the material so that it will not absorb moisture from the atmosphere as it is shipped or stored.

The electrolytic process used in the present commercial production of the metal is the same as that which was discovered by Hall thirty-six years ago. The aluminum oxide is dissolved in a bath of molten cryolite, a mineral which occurs in Greenland and which melts at a temperature around 1700°F. This solution conducts the electric current and at the cathode where the current leaves the solution, metallic aluminum is deposited in the liquid form. At the anode, oxygen is liberated which combines with the carbon to form carbon dioxide which escapes into the air. For the production of one pound of aluminum approximately two pounds of aluminum oxide are required and something less than one pound of carbon anodes is used up in the production of carbon dioxide.

The reduction plants are located in the vinicity of cheap electric power developments since something less than one dozen kilowatt hours is required for the production of one pound of aluminum which is sold for less than 25 cents per pound.

The outstanding property of the metal is its lightness, the specific gravity being approximately one-third that of the other structural metals in common use. In addition, it is quite resistant to atmospheric corrosion and to a considerable number of chemical substances in common use. Of outstanding interest in the railway field is the fact that aluminum is not attacked by the gaseous compounds of sulphur which may result from burning the ordinary grades of soft coal.

Aluminum is also easily worked and fabricated into a variety of forms which are required for structural purposes. The

electrical conductivity of the metal is high, being 61 per cent of that of copper, but because of the difference in specific gravity of these two metals, a pound of aluminum wire of given length will conduct twice the current that would be conducted by a pound of copper wire of equal length under the same voltage. The thermal conductivity is likewise high, which fact accounts for many uses of the metal.

Pure aluminum is soft and quite weak compared with other structural metals. By cold working it, the tensile strength may be more than doubled but the resulting material can withstand comparatively little further forming. By the addition of other elements to form alloys, it is possible to increase the tensile strength of the metal and at the same time retain considerable ductility. By this simple alloying process using manganese, magnesium, copper, silicon or some combination of these elements, it is possible to obtain alloys which in the annealed state have approximately half the strength of steel. After these alloys are cold worked, still higher strengths are obtained, but here also the ability to carry out forming operations on the resulting fabricated products is materially lessened.

Shortly before the war a German metallurgist by the name of Wilm discovered that the alloy of aluminum, which he called Duralumin, containing 4 per cent of copper and ½ per cent each of manganese and magnesium was susceptible to heat treating operations to improve its mechanical properties. Since that time other alloys have been discovered which also respond to heat treatment processes and it is on the basis of these discoveries that the present development in the structural applications of the metal are based.

If wrought products made from one of these heat treatable alloys are heated to a temperature somewhat below their melting point and quenched, there is a pronounced increase in the tensile properties of the material. In the case of duralumin or 17S as it is called by our company, the tensile strength immediately after quenching is about 45,000 pounds per square inch as compared with 26,000 pounds per square inch in the annealed condition. Moreover, if this alloy is allowed to stand at room temperature for a few days, there is a further increase in tensile strength to about 58,000 pounds per square inch. Not only is there an increase in the tensile and yield strengths of the material, but also an increase in the elongation. It has thus been possible to produce an alloy which is only slightly more

than one-third as heavy as steel and which has mechanical properties comparable with those of structural steel.

In response to the demands for this alloy in the various forms which are required for structural purposes, mills have been built to produce plates and shapes in addition to the sheet and tubing which could be produced on the equipment which had previously been available for the fabrication of the ordinary aluminum alloys. The largest shape which is at present in commercial production is a 10-inch ship channel in 85 feet finished length. Plates are available in the range of sizes in which steel plates are commonly produced.

Some of the applications for which these materials are employed will be discussed by Mr. Woollen in his talk which follows.

PRESIDENT: This is a triple bill tonight, and we have two speakers following Dr. Faragher. Before we go to the next subject we will be glad to hear any questions you have regarding the subject just presented by Dr. Faragher. If you have no questions we will proceed to the next subject, "Some Applications of Aluminum Alloys in the Transportation Field", which will be presented by Mr. A. H. Woollen.

Some Applications of Aluminum Alloys in the Transportation Field

By A. H. WOOLLEN,

Engineer, Development Division, Aluminum Company of America

(NOTE:—The author showed 45 lantern slides and explained these slides).

Mr. President, Members of The Railway Club of Pittsburgh, and Guests, I am not going to make a long preamble, but intend to show you some typical applications of aluminum alloys in the transportation industry in a series of slides which I have grouped chronologically into the railroad and heavy traction class, light traction such as street railways and buses, and automotive trucks.

The first slide is an exterior view of the Pennsylvania Railroad suburban electric motor car, known as their type MP54. This is the first application of aluminum to railroad cars of which I know where the entire body above the underframe was constructed of aluminum alloys. The second slide shows the interior body framing before the insulation and finish were

applied. The third slide shows a standard walk-over seat as used in this type of car, of which all the parts are built of aluminum alloys.

The fourth slide shows a multiple unit train on the Illinois Central electrified suburban service. Some of these cars were built as early as 1923 with aluminum roofs, interior finish doors, and miscellaneous fittings. Two hundred and sixty are now in service with about the same applications. The next slide shows the interior of this car. The next slide shows an aluminum conduit installation as applied on the Illinois Central motor car. Over 3,000 ft. of conduit was used for this car. Slide 7 shows three generations of motive power on the Illinois Central, the extreme left being the first steam engine used, dated about 1840, and the second suburban type engine which was replaced with the multiple unit motor car on the extreme right. Slide No. 8 shows the Chicago and Northwestern suburban car, 145 of which are in service. This was the first quantity production lot of cars having aluminum bodies with outside sheets, girder plates, as well as interior finish roofs, etc. The next slide shows the interior of the same car. The ninth slide shows the Delaware, Lackawanna and Western multiple unit suburban car put into service last year. One hundred and forty of these are equipped with aluminum roofs, interior finish, bulkheads, doors, salons, and miscellaneous fittings. The next slide shows the interior of the same car. Slide No. 11 shows the new Philadelphia and Reading multiple unit suburban car put in service in 1931. Seventy of these are equipped with aluminum roofs, interior finish, partitions, vestibule floors and steps, and many applications in the motor and control equipment. The next slide shows the interior of the same car. Slide No. 13 shows a typical application of aluminum roof sheets as they are applied in the car builder's shop.

Slide No. 14 shows the first all-aluminum car including underframe as well as body structure. It is a high speed interurban car operating between Indianapolis and Louisville. Thirty-five of these were placed in service about a year ago. The next slide shows the body framing and underframe of this car. You will note the construction is somewhat similar to a steel car, although the parts are all made of strong aluminum alloy. The next slide shows the skeleton framework of this body from the outside. Slide 17 shows a high speed streamline interurban car on the Philadelphia and Western Railroad. Practically the entire body and underframe are constructed of alu-

minum alloys. The next slide shows the body framing from the outside. The next slide shows the interior of this car. It will be noted that the space covered by cast aluminum grills between the upper and lower headlining sheets permits ventilation of the car by motor driven blowers located at the end. The next three slides show the views of an accident which occurred to one of these Philadelphia and Western cars. Even though the car crashed into another at fairly high speed, about 35 miles an hour, the entire impact was absorbed in the anti-telescoping plates and no injuries resulted to passengers in the car, and not a pane of glass was broken outside of the end vestibule, which was partially collapsed by the force of the impact. Other aluminum cars in wrecks have demonstrated this same ability to absorb impact and protect their passengers.

Slide 23 shows an Alton and Southern Railroad locomotive, where we have made an experimental installation of aluminum alloy main and side rods. This locomotive also has aluminum cab, boiler jacket, and various miscellaneous applications. The next slide shows a valve motion of aluminum on a Nickel Plate locomotive which has given very satisfactory results as far as life and service are concerned. Slide 25. The Delaware and Hudson Railroad redesigned their high speed passenger engine for greater boiler pressure. This resulted in heavier cylinders, rods, and running gear until the weight of the locomotive exceeded that allowed by the Maintenance of Way Department. We were able to take off 10,000 lbs. weight by installation of aluminum cab and other units, including brake cylinders and main reservoirs. Slide 26. This hopper car is frankly an experiment. We have built ten of these for our own service primarily, but have farmed out one in the sulphur trade, three in miscellaneous coal trade, three in special coal trade involving car unloading apparatus, and three are in our own service hauling bauxite. The cars are constructed entirely of aluminum alloys, including underframe of rolled structural shapes built up to equal the A. R. A. center sill. We believe that they will be interesting to the railroads when we have proved their ability to stand up in service, both from a maintenance and corrosion resistance standpoint. Slide 27 and 28 show details of these cars.

Slide 29. Dr. Faragher mentioned a little while ago to you that aluminum was resistant to the corrosion of a number of chemicals. The converse is true naturally, and certain chemicals can be transported without contamination in aluminum

tank cars. Over fifty of these are in service in this special trade, carrying such products as glacial acetic acid, hydrogen peroxide, formaldehyde, turpentine, resins, and other special products satisfactorily and economically. These products were formerly carried in either small containers or in glass or lead lined tank cars. The next slide shows two of the aluminum tank cars which have been in a wreck, rolling over a bank on top of each other. They stood up very well, only a small hole being punched in the side of one of them. We are told that steel cars in a similar condition would have collapsed entirely.

We now leave the railroad equipment and the next slide, No. 31, shows the first aluminum street car, built for Cleveland Railways, an exhibit at the American Railways Convention in 1926. The next slide shows the underframe of the same car, showing the structural aluminum members used for the first time in this kind of service. This car had all-aluminum trucks which, after 300,000 miles of service are in excellent condition. Slide No. 33 shows a city type street car built for the Chicago and Joliet electric railway a year later. This car is also in excellent condition today. Slide 34 shows a street car which you have probably seen, No. 6002 of the Pittsburgh Railways. Slide 35 shows a typical street car underframe of aluminum alloys, ten of which are in service in Montreal Tramways. Slide No. 36 shows a typical all-aluminum trolley coach or street car type bus. Slide 37. This is an all-aluminum bus body which has seen 500,000 miles of service and worn out three chassis. It is in service on the Pacific Coast. The next slide shows a standard M.C.B. type fully equalized motor truck, suitable for high speed service. This design is most suitable for substitution of aluminum alloys in place of steel. This truck has been designed and it is hoped to put a pair of them in service shortly. Slide 39 shows a street car type truck of aluminum alloys which has been in service over three years with satisfactory results. Slide No. 40. This is a typical example of an aluminum tank truck and tank trailer for the transportation of gasoline. These units very quickly repay extra first cost by the additional payload which can be carried under existing highway laws.

The next slide shows an extra heavy duty dump truck body of aluminum, which also pays for itself very quickly by carrying extra payload. Slide 42 shows a typical van type aluminum body, which is also a money maker for its owners, due to the extra payload which the light weight aluminum alloys

allow it to carry. Slide 43 shows a demountable merchandise container suitable for truck or rail transportation built of aluminum alloys. The growing interest of the railroads in this form of transportation unit is noted on all sides and aluminum is particularly suitable and pays for itself very shortly in this kind of service. Slide 44 shows a typical all-aluminum chassis construction, a number of which are in service and permit additional payloads, thereby proving their economic worth. The last slide shows an all-aluminum, lighter than air dirigible, built entirely of aluminum alloys. The covering of this ship is fine hard rolled aluminum sheet put together with metal stitching to make a gas-tight envelope.

In closing, I would like to state that in general the application of aluminum alloys to transportation vehicles will cost from 15 cents to 20 cents per pound of weight saved over former material, such as steel, wood, etc. In railroad service it is generally assumed that saving in weight is worth about 3½ cents per pound per year, so that the amortization of the extra cost of aluminum occurs in from three to five years. In automotive vehicles, particularly trucks, the increase in payload will return the increased investment in less than one year.

PRESIDENT: Does any one wish to ask any questions of Mr. Woollen?

MR. SAMUEL LYNN: I am very much pleased to be at the meeting and have the opportunity of hearing the paper presented by the speaker this evening, also to see the pictures showing the use of aluminum on railroad equipment. As I listened to the paper, it recalled to my mind a visit made to the Aluminum Company's plant some months ago when we were privileged to make an inspection of one of their new all-aluminum hopper cars. I do not know whether or not the hopper car shown on the screen was the same car that we inspected at that time, however, I understood the inspector to say that the cost of the aluminum car would be about 20 cents per pound higher than the hopper car constructed of steel. If I recollect correctly, we were informed at the time we made the inspection of this car that the cost of the aluminum car would be about double that of the same capacity car built of steel. In other words, on a steel car costing approximately $2,500, if the entire body were constructed of aluminum, we could figure on double the cost or approximately $5,000. While making the inspection at the plant of the Aluminum Company, I made some notes and

unfortunately I do not have them with me this evening. I recall, however, that there was considerable difference in the lightweight of the all-aluminum car as compared with the all-steel car. I believe the aluminum car was from 20,000 to 21,000 pounds lighter.

After listening to the paper this evening, I am wondering whether any changes have been made in the production of sides for railroad equipment, which would enable the Aluminum Company to reduce their costs for materials used in freight car construction.

Another factor to be considered is what information has been developed regarding the life of the car constructed of aluminum as compared with the steel car. It is my understanding that the aluminum freight car has not been in service a sufficient length of time to obtain any correct data for comparison of the two types of car from a service standpoint.

There were some very interesting pictures displayed this evening showing the bodies of aluminum passenger cars and I was particularly interested in the picture showing the damage which occurred to the car in accident. However, there is quite a difference between the usage of passenger and freight car equipment, the freight car being subject to all kinds of abuse in loading and unloading various commodities, whereas the passenger car body is entirely free from abuse, except in case of an accident such as was shown on the screen.

MR. WOOLLEN: The figure I gave, 15 cents to 20 cents per pound of weight saved in the case of the hopper car additional cost is the same I gave you that day and is about double the cost of the steel car. That figures about 12½ cents per pound of weight saved in that particular car because of the particular alloy in this car.

As to the life, we will have a great deal more to say later on. We are very optimistic.

PRESIDENT: Has any one else anything to add? Professor Endsley, have you anything to say?

PROF. LOUIS E. ENDSLEY: Some years ago a very eminent railroad man calculated that it would cost $22.00 a ton to haul the dead weight of a freight car per year. That was put up to $33.00 by another very eminent railroad man some years later. You can take either figure. That means for every ton of weight saved in a freight car a railroad can pay $220.00

to $330.00 more per ton saved. If a saving of 10 tons is made the cost can be $2,200.00 to $3,300.00 extra.

I was very much interested in the point brought out regarding the modulus of elasticity, which might be enlarged on a little, that the modulus of elasticity of the aluminum alloy is only about one-third that of steel. That means if I have two rods of the same length and size and elastic strength, and we put the same load on the two of them, the aluminum bar will stretch three times as much as the steel. That means if you try to stretch these through the impact of a falling weight, it will take three times as much energy to reach the elastic limit of the aluminum bar. This will be a very good thing when we get heavy impacts in switching of freight cars. That is the reason the old wooden car stood so much bumping around because the modulus of elasticity of wood is only one-tenth that of steel.

I have enjoyed very much listening to these talks.

PRESIDENT: Any one else? Mr. Rufus Flinn, General Superintendent of the Pennsylvania Railroad, is present. Would he wish to make any comment?

MR. RUFUS FLINN: I do not believe I have anything to say at this time. I have enjoyed the addresses very much.

PRESIDENT: I see Mr. Karl Berg. What have you to say about side rods and valve gears in this connection?

MR. KARL BERG: I was also with the delegation given the privilege of learning something about aluminum and its manufacture at New Kensington some months ago, and for that reason have enjoyed all the more the privileges of listening to the lecture here tonight.

I cannot, at this time, find any question of importance to ask.

PRESIDENT: Mr. Lanahan, have you anything to say about this subject? We would be very glad to hear from you before we close the discussion.

MR. FRANK J. LANAHAN: I do not suppose any of you would expect a fellow to laugh at his own funeral.

(It took about six seconds for that to soak through, but when the crowd caught it, they roared).

My position at this meeting, given to the substitution of aluminum for other metals, reminds me of the two sparrows

perched on a tree by the roadside, when there went by the first automobile. The cock sparrow dropped his head in evident distress and sorrow. Mrs. Sparrow, observing his grief, inquired, "My dear, what is the trouble?" He pointed his little beak to the horseless carriage and said, "Darling, that's going to kill our meal ticket."

If my good friend, Mr. Hunt accomplishes all that their program here this evening implies, it is evident what will become of my malleable iron business. We might hope that some kind of an arrangement could be made to eliminate the caboose, that our product could be fastened to the end of this wonderful aluminum train.

Truly remarkable has been the development of aluminum, and it is convincingly demonstrated to us tonight, that we are living in an age of progress and we cannot lose sight of the economic law of the "survival of the fittest". As Pittsburghers, we are all proud of the great achievements in the marvelous accomplishments of this phenomenal Pittsburgh Corporation, and irrespective of selfish interest, it has been a wonderful demonstration.

PRESIDENT: We have with us Mr. D. J. Whalen, of Canton, Ohio. He has come some distance to be here and we would like to hear from him briefly.

MR. D. J. WHALEN: I built seven of the aluminum cars which in itself should be sufficient for me to say. I thought I had better go to New Kensington and learn something about the material which I did, gaining quite a lot of information of interest during my two or three day stay. For anyone working with this material it is well worth while to go to New Kensington and find out whether or not all the money spent in aluminum investigation has been wasted. You will find many things that will surprise you and will gain a lot of knowledge concerning aluminum and its practical uses.

Coming back home I made up my mind I could build the aluminum cars without worrying about bending, heating or working the aluminum in general. It was a pleasure for me to build the cars, not being such a big job afterall. Having built the cars I am mighty proud of them and I think we shall hear a lot about them.

Of course in the old days on special designs and new materials we had our "ups and downs" and we will have to hear from the new cars in actual use.

PRESIDENT: We are now going to have some moving pictures and I am not French enough to pronounce the name of what you are to see but the speaker is going to portray the diversion of the Saguenay River by a very unique method, the "Chute a Caron obelisk". This will be presented by Mr. James W. Rickey, Chief Hydraulic Engineer.

Building a Concrete Dam "On End" and Blasting It Into Position

By JAMES W. RICKEY,

Chief Hydraulic Engineer, Aluminum Company of America

(EDITOR'S NOTE:—June 19, 1932, James W. Rickey gave an address on the novel method used by him to divert the Saguenay River, above the site of Chute a Caron dam, thus enabling the building of the closure section of the main dam across the river channel where the swift rapids were more than 75 feet deep and 200 feet wide. Mr. Rickey's address was illustrated so largely by lantern slides and moving pictures that it could not be reported stenographically. However this address followed so closely the text of a paper presented by C. P. Dunn to the American Society of Civil Engineers, and published in CIVIL ENGINEERING for December, 1930, that we are combining Mr. Rickey's opening remarks with extracts from Mr. Dunn's paper. The illustrations are reproduced in Mr. Rickey's paper through the courtesy of American Society of Civil Engineers).

Introduction. Aluminum is extracted from an aluminous rock, known as bauxite, by an electrolytic process requiring large amounts of electrical energy. To meet the ever widening demand for aluminum, notably in the form of light and strong structural alloys, the two North American producers of virgin aluminum are engaged in an extensive program of plant expansion, and, by the nature of the reduction process, these plans primarily involve increases in the required supplies of electrical energy. To this end is being developed one of the largest water-power sites in the world. Known as Chute a Caron, this development is located in the Province of Quebec on the Saguenay River, 80 miles above its confluence with the St. Lawrence and 25 miles below Lake St. John. It is within 20 miles of deep-water navigation at Ha Ha Bay. (See Fig. 1.)

This project is part of a general program begun in 1925 when the Aluminum Company of America was attracted to this region by the combined advantages of cheap electric power and easy access to the ocean trade routes of the world. The Aluminum Company of Canada (then a subsidiary of the Aluminum Company of America, but later sold to a Canadian firm, Alu-

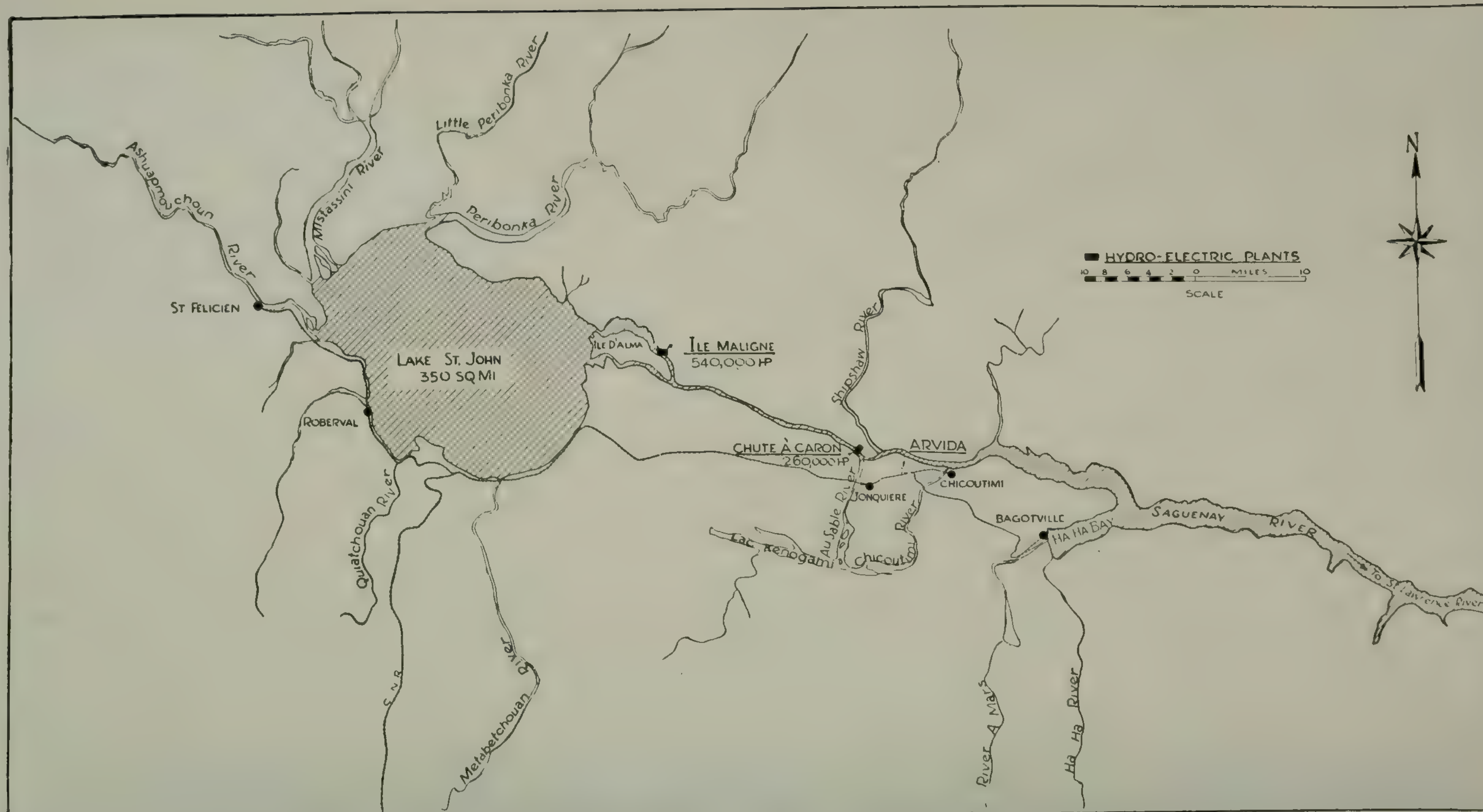

FIG. 1.—Map of Saguenay River and Lake St. John District.

minium, Limited) entered the territory to build a large reduction plant and an industrial village known as Arvida. The town site was planned for an ultimate population of thirty-five thousand people.

The Saguenay River. The drainage basin of the Saguenay River is not accurately mapped nor is its area accurately known, but it is estimated to be at least 30,000 square miles. The maximum flow into Lake St. John during the period recorded 1913-1930, occurred in 1928, when it was 405,000 second feet. Due to the regulating effect of this lake, which has an area of about 350 square miles and a useful storage capacity of 220,000,000,000 cubic feet (5,000,000 acre-feet) below the normal maximum level, the corresponding outflow was only 326,000 second feet. The minimum outflow from the lake is approximately 20,000 second feet. The regulated flow for power purposes is about 35,000 second feet.

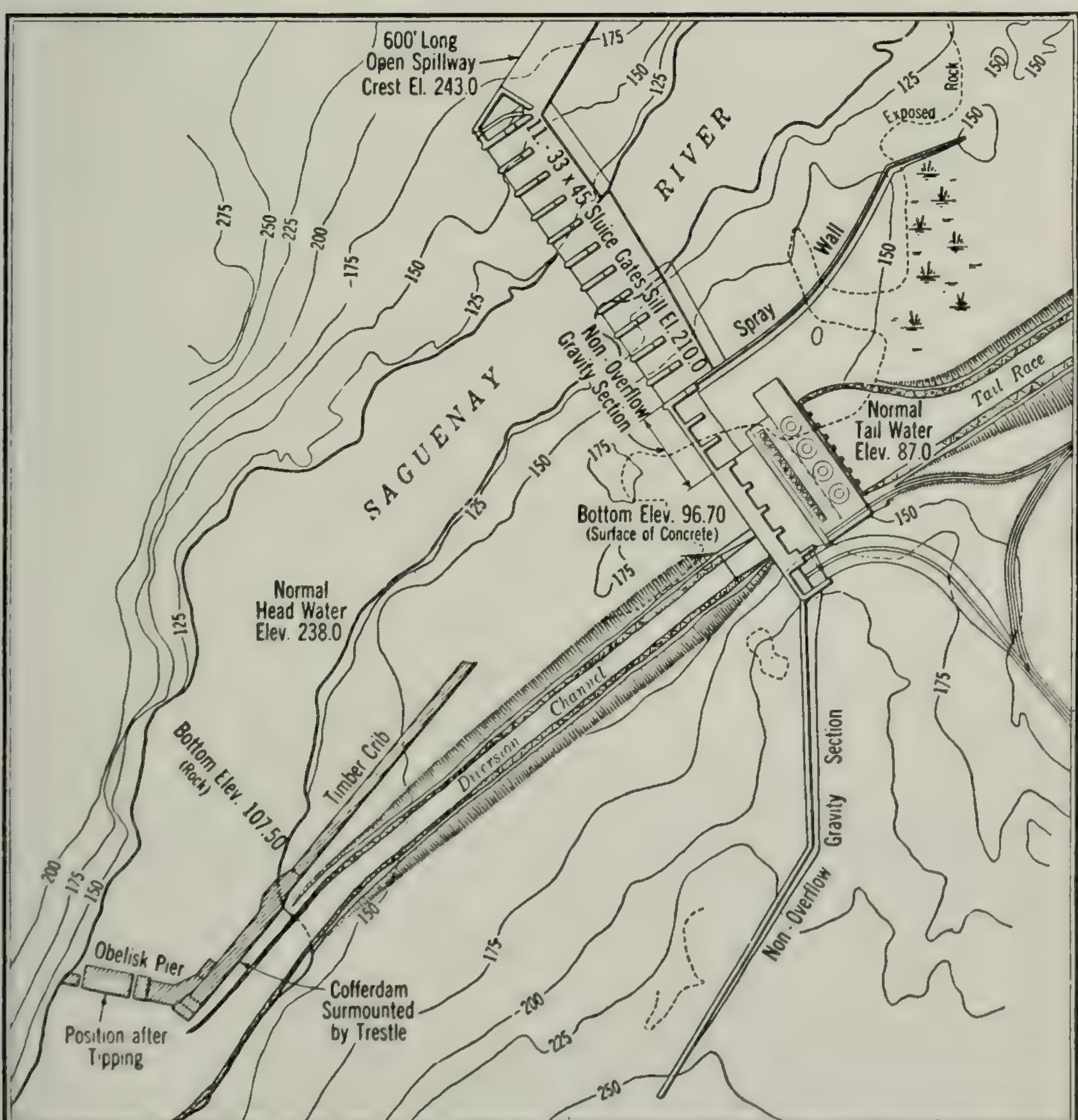

FIG. 2.—Contour Map of Dam Site.

Chute a Caron and Shipshaw Projects. One-third of the total fall below Lake St. John was developed in 1925 by the Ile Maligne hydro-electric plant operating under a head varying from 90 feet at maximum flood to 119.5 feet at low tail water and full reservoir in the lake. Development of the remaining fall of about 208 feet was planned originally in one stage with an ultimate power-house capacity of 1,000,000 horsepower, developing more than 800,000 horsepower years of primary power.

On account of the magnitude of the undertaking, advantage was taken of the natural conditions at the site which permitted the development of a preliminary stage, known as the Chute a Caron project. As shown by Fig. 2, this project includes a massive gravity dam located above the rapids at Chute a Caron, together with the diversion works required for the construction of the main dam in the old river-bed and also includes a canal intake for the ultimate stage of development, known as the Shipshaw project. By the construction of a power-house at the intersection of the Chute a Caron diversion canal and the main dam, the available fall of 151 feet at that point is utilized with minimum initial expenditure and the demand for power met in the shortest practicable time. A total of 260,000 horsepower was developed in this preliminary stage.

While this initial development is thus yielding a fair return on the big investment in the main dam, construction can proceed on the Shipshaw project—the ultimate development—in accordance with future power requirements. This latter work, requiring three years' time, will include the construction of three large earth dams, a concrete combined spillway and forebay bulkhead at the lower end of the canal, and about 3,000,000 cubic yards of earth and rock excavation to form the power canal leading from the reservior, above Chute a Caron dam to

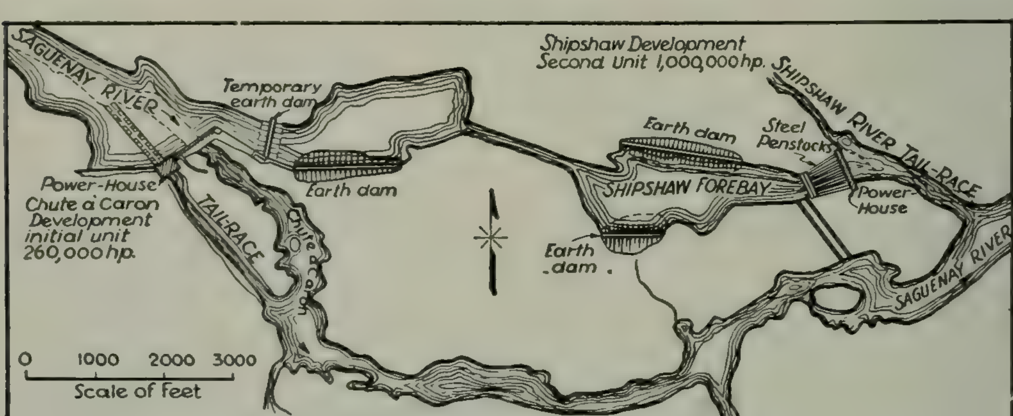

FIG. 3.—Map of Shipshaw Development.

the Shipshaw power-house forebay. This canal will be located along the north bank of the river. (See Fig. 3.) Shipshaw power-house will probably be built in several stages of two or three hundred thousand horsepower each and, when completed, will be one of the largest of its kind.

The Chute a Caron plant contains four hydro-electric units of 65,000 horsepower capacity each, under the normal head of 151 feet. The Shipshaw plant has been tentatively laid out for an ultimate capacity of 1,000,000 horsepower, as above stated, delivered either by ten 100,000-horsepower units or eleven 90,-000-horsepower units under a net head of 205 feet.

The foregoing will be sufficient to give a picture of the general power project. The main feature of our talk tonight is a description of the novel method of diverting the river to enable the building of the closure section of the dam across the main river channel. (The remainder of the address was illustrated by lantern slides and moving pictures.)

The general plan of the project, Fig. 2, shows the arrangement of the permanent works and the diversion canal. The most economical layout dictated that the diversion canal and the powerhouse tailrace should be combined; that is, the portion of the diversion canal downstream from the dam eventually served as the tailrace. Upstream, the diversion canal is at a higher level, because of the 50-ft. drop where the canal passes through the dam. The closure gates in the diversion canal were located on the line of the upstream face of the dam. They were two in number, each 20 by 40 ft., of the Stoney type, and operated by two 100-ton blocks with 18-part tackle, provided with a double-drum electric hoist.

Surmounting the entire diversion cofferdam, including the part across the main channel, the "obelisk," Fig. 2, is a railroad trestle, which also provides support for a timber needle dam. The trestle was used in hauling stone, sand, and clay for sealing operations and was used for operating the needles.

It was not economically feasible to construct a diversion channel large enough to take the maximum autumn flood, which may reach 180,000 sec-ft., or even the normal autumn flood of 100,000 sec-ft. The plan was that when the river discharge was less than 50,000 sec-ft., the needles were in place and the entire flow would pass through the diversion canal, thus allowing work to proceed on the dam in the main channel. When the discharge was more than 50,000 sec-ft., however, the needles were removed and water flowed over the cofferdam, making it

necessary to discontinue work in the main channel. If the total flow should reach more than 100,000 sec-ft. for any considerable length of time, the trestle and timber frame structure would be destroyed and would have to be replaced when the flood receded. There was a 30 per cent chance that such destruction would occur, but it was believed to be more economical to take this chance than to build much more costly structures which would surely withstand maximum autumn floods. Fortunately such a flood did not occur.

Large Flow to be Expected

In part, the flow of the Saguenay is regulated by the operation of the Ile Maligne hydro-electric station 23 miles upstream. It is necessary for Ile Maligne to discharge 15,000 sec-ft. on Sundays and 35,000 sec-ft. on week days. Maximum floods, which cannot be controlled at this station, may reach 400,000 sec-ft. in June, due to melting snow, and 180,000 sec-ft. at any time in the summer or fall, due to rains.

In addition, the necessity for diverting a flow amounting to 35,000 sec-ft. during the low-water season, in a stream with steep slope and high velocity, made the cofferdamming and diversion problem one of unusual magnitude.

Unique Cofferdamming for Main Channel

After the diversion canal entrance had been cofferdammed and excavated by ordinary methods, and the cut-off cofferdam removed, the diversion cofferdam, a rock-filled crib, was carried as far out into the stream as was possible by ordinary construction methods. The last step of the diversion, the closure of the main channel, was accomplished on July 23, 1930, by a novel method.

In brief, this method consisted of building a precast concrete dam, standing on end, at the side of the main channel, and tipping it over at the proper time into the main channel. This scheme for placing a precast monolithic dam accurately in position had not been used before. Essentially, it involved the following features: (1) a fixed pier, relatively massive, to carry the greater part of the weight and thrust; (2) a small pier carrying part of the weight, to be blasted away; (3) a cylindrical rolling face on the fixed pier, so designed and placed, at such a location and elevation, that the precast dam would fall into an accurately predetermined position. These features are illustrated in some detail in Fig. 4.

The term "obelisk" was early applied to the precast dam

because, before the dimensions were known, it was mentally pictured as a slender shaft. As constructed, it was rather plump and bore little resemblance to an Egyptian obelisk. But the name stuck, just the same.

Fortunately, a convenient location for the final closure was available, a point where the main channel was about 110 ft. wide, and 23 ft. deep at extreme low water, with a water veloc-

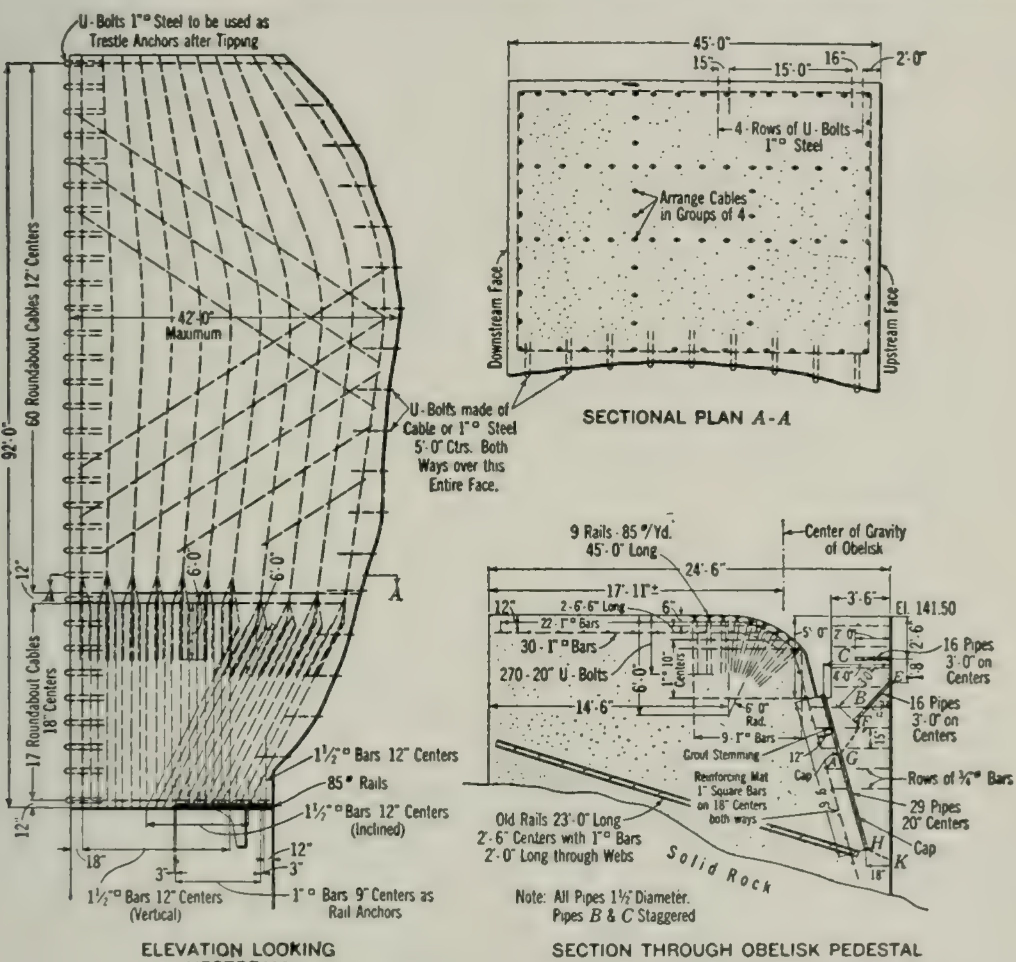

FIG. 4.—Sections Through Obelisk. Predicting and Accomplishing the Fall

ity of about 20 ft. per sec. On the west side of the main channel was a projection of bedrock which formed an island at extreme low water. The ordinary crib cofferdam structure could be carried across the shallow part of the river to this island, but no further. It was therefore chosen as the proper spot on which to build the obelisk.

A Concrete Water Plug

Accurate determination of the topography of the river bed in the main channel was, therefore, a necessity. It was accomplished by taking soundings with a 1,000-lb. cast-iron ball, sus-

pended from a cableway, and operated by a hoisting engine, the cableway being shifted up- and downstream so that the desired area could be thoroughly covered. As these measurements fixed the dimensions of the obelisk, the success of the closure is in large measure due to the skill and care of the riggers and survey crew in making these soundings.

As built, the obelisk was 92 ft. high, 45 ft. thick up- and downstream, and had a maximum depth of 40 ft. (Fig. 4). It contained 5,400 cu. yd. of concrete, weighing 11,000 tons. The face toward the channel was contoured to fit the bottom of the river, and the fit accomplished was remarkably close. In its final prone position, the obelisk checked the calculated location within 1 in. in lateral measurements up- and downstream and transversely across the river. Its top surface, 45 by 92 ft., was within about 1 ft. of the planned elevation, being about 2 ft. out of level across a diagonal from highest to lowest point. Although it fell in swiftly moving water 28 ft. deep, the obelisk was not carried downstream at all, as far as could be observed; in fact, the top surface was not even wet.

Predicting and Accomplishing the Fall

Because of lack of precedent and scarcity of knowledge of what would happen when 11,000 tons of concrete dropped into swiftly moving water 28 ft. deep, unusual caution was observed in the design. Spaces 8 ft. wide were left at each end of the calculated prone position of the obelisk, these to be closed later by stop logs, pushed and rolled down the face of the obelisk and the adjoining piers, working from the top downward. After the obelisk was in final position, it was found that the spaces at its ends could have been made narrower; but even so they were not difficult to fill.

In order to get the correct combination of shape of pier, location of pier, elevation of top of pier, radius of cylindrical rollway, and contour of face of obelisk, it was necessary to calculate the path of the falling body. This was a matter of fairly simple mechanics, there being few uncertainties. The uncertain items, which could not affect the result to any appreciable degree, were as follows:

1. Air resistance. This factor was neglected.

2. Coefficient of friction between the cylindrical rollway and the base of the obelisk during the fraction of a second just prior to the cessation of contact. This coefficient was estimated. An error would have had no very great effect on the final result.

3. Effect of water cushion. This was calculated roughly by assuming that the obelisk momentarily displaced $1\frac{1}{2}$ times its own volume of water. The displaced water being accelerated and removed in a known fraction of a second, it was possible to calculate the retarding force applied to the obelisk.

Model experiments indicated that this crude assumption was reasonably close to the truth. In the model, and in the prototype also, the impact was measured by recording the motion of weighted springs carrying a stylus, which left a record of its movement on smoked glass.

Proportions of the main supporting pier, the rollway, and the obelisk were fixed so that the base, or the end nearest the supporting pier, would strike the river bottom a fraction of a second before the outer end; that is, the obelisk had not rotated a full 90 deg. before it touched bottom. The plans were made in this way because it was believed that there would be less probability of the mass being shattered if the lower end touched first. As it later developed, this precaution, combined with the other preparations, was ample to ensure the safe dropping of the huge mass.

During the progress of the design, the idea persisted that the huge mass of concrete, falling on the rock of the river bottom, would be considerably shattered. It was considered neces-

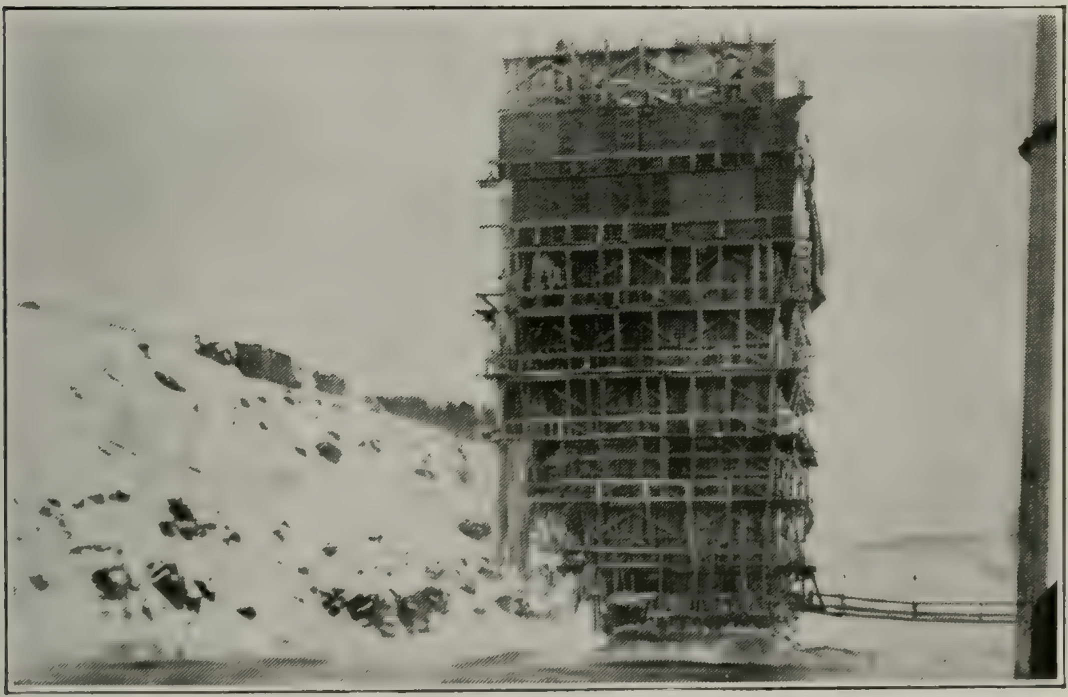

FIG. 5—WINTER CONSTRUCTION ON OBELISK
Note Forms, Housing for Heating, and Ice Formed by Condensed Steam
Studies for Reinforcing

sary to heavily reinforce the entire mass, so that the whole would be held together after this occurred. For reinforcement, old steel cables were largely used. They were preferred to reinforcing steel because of their greater flexibility. In addition to the longitudinal cables grouped in fours, diagonal strands were placed throughout the mass so that no matter what direction might be taken by a line of fracture, it would be crossed by cables nearly perpendicular to it, which would hold the fragments in place. For example, in the upper two-thirds of the obelisk, enough diagonals were inserted to insure that at least 60 per cent of them would cross any horizontal plane.

Much to everyone's surprise—and probably because of the amazingly accurate fit of the obelisk to the river bottom and the effectiveness of the water as a cushion—there was no shattering into fragments. The precast dam remained a monolith after falling, with only a few small hair-like cracks produced. This might indicate that more reinforcing steel than necessary was used; but, if performing a similar operation again, I would hesitate to reduce the amount because another time there might not be such an accurate fit of the dam to the river bottom, and greater impact would result.

In connection with this particular problem, some interesting

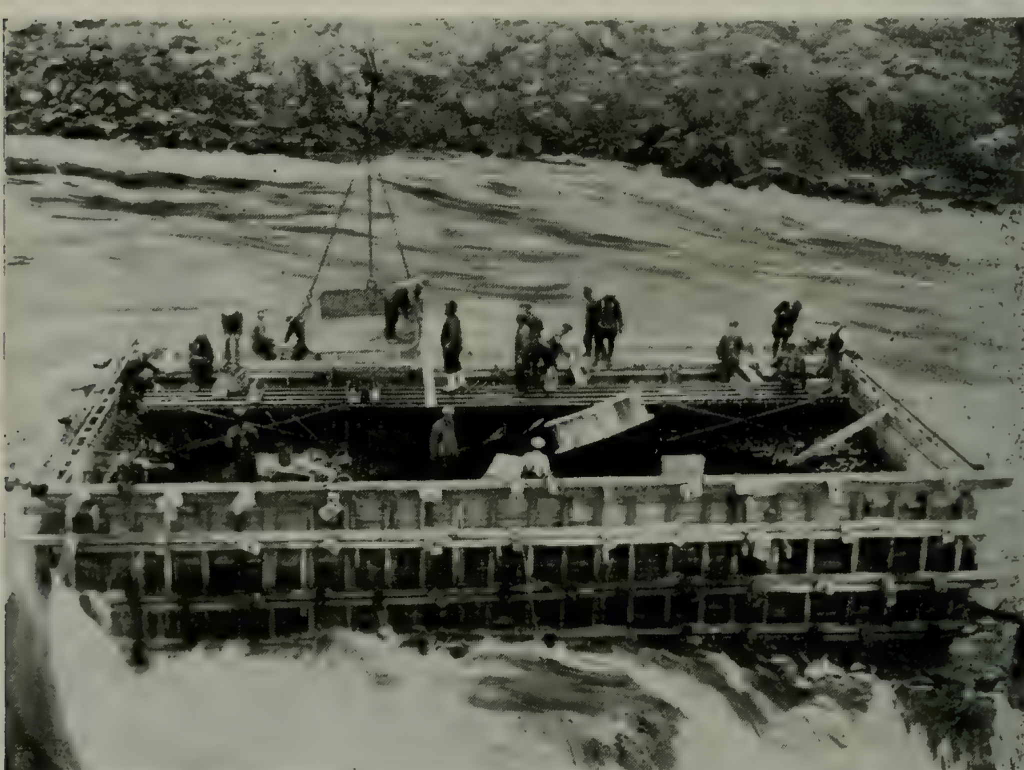

FIG. 6—CONSTRUCTING OBELISK FOUNDATION
Cofferdam Enables Pouring During High Water

data were developed by building models of very weak concrete, having strength in correct proportion to that in the prototype. For example, the obelisk itself was built of 2,400-lb. concrete, whereas some of the models tested had a strength of only 60 lb. per sq. in.

A Winter Job

Conditions required that the obelisk structure be built during November and December, 1929. Cold weather concreting was necessary because the pier could not be started until extreme low water, late in the fall, and the structure had to be completed during the low-water period, while there was convenient access to the equipment for concreting. The concrete was placed with a derrick, using 4-yd. buckets. Lifts of 10 ft. were used except near the bottom where the forms overhung, and it was impractical to hold them for depths greater than 5 ft.

Temperatures during a large part of the concreting period were from 20 to 30 deg. below zero. The surface of the concrete was kept from freezing by housing in with light timber frames, canvas, and building paper about 2 ft. away from the forms, and by discharging live steam into the space between. The accumulation of ice from the condensed steam is shown in one of the photographs. The concrete, however, was not frozen. It is greatly to the credit of the construction organization that this difficult and dangerous work in cold weather was accomplished without any accidents.

Obelisk Topples at Second Attempt

On account of the enormous weight involved, the only practical way of tipping the obelisk was to build it on two piers, one to be removed by blasting. The main pier, farthest away from the channel, Fig. 4, was by far the more massive of the two and carried about two-thirds of the weight. The center of gravity of the obelisk overhung the tangent point of the cylindrical rollway by 3 ft. 5 in., this giving a starting moment of about 75,000,000 ft-lb. The small pier, which was blasted away, was 3 ft. 6 in. thick, and carried about one-third of the total weight.

Blasting holes, arranged as shown in Fig. 4, were provided when the pier was built, it being planned that the lower holes would be fired first, splitting off the pier, and that the small holes would be fired by delay exploders about 1 sec. later, demolishing the structure so that large fragments would not

prevent the obelisk from settling into place properly. The holes were formed by imbedding pipes in the concrete. The first charge used totaled 180 lb. in 61 holes, amounting to 2¼ lb. per yd. of material to be removed.

Referring to Fig. 4, the loadings used in each hole were:

Holes A. Eleven cartridges of 40 per cent gelatin, 1¼ by by 8 in. were detonated by two electric blasting caps, one cap in the fourth and one in the ninth cartridge from the bottom. Dry grout was used for stemming.

FIG. 7—THE OBELISK TIPS INTO PLACE
Water Splashes 150 Ft., Smoke Obscures Flying Forms

Holes B. Two cartridges, 40 per cent gelatin, 1¼ by 8 in., were primed with one first delay electric blasting cap, and the holes filled with grout to the collar.

Holes C. One cartridge, 40 per cent gelatin, 1¼ by 8 in., was primed with one first delay electric blasting cap.

This first charge was insufficient to remove the pier because the specified delay blasting caps were not then procurable, and the obelisk failed to tip. The pier broke along the line *E F G H K*, as shown in Fig. 2. At the second try, about 3 hours after the first, the small pier was successfully shattered by placing 1,000 lb. of 60 per cent powder in the recess between the two piers. This effectively destroyed the remaining part of the small pier without damaging other parts of the structure. It was unfortunate that so much powder was used, because the

smoke obscured the falling obelisk so that the moving picture record of the fall, taken for scientific purposes, was incomplete.

Cushioning the Impact

During the progress of the design, there had been considerable discussion of various schemes for cushioning the fall so that the mass of concrete would not be shattered too greatly by impact upon the rock stream bed. It was early suggested that the face be completely padded with something in the nature of baled hay, or a layer 4 feet thick of spruce poles lashed in place. A study carried out in the testing flume at Carnegie Institute of Technology with the aid of a model indicated that the best, and in fact the only, practical cushion would be an ample depth of water.

One of the most useful results of the model tests was in checking the calculations of the performance of the water cushion. The proper depth in which to tip the obelisk having been determined, this depth—28 feet—was obtained by adjusting the gates Ile Maligne a few hours before the obelisk was tipped. The cushion was thoroughly effective and did not cause any objectionable motion downstream or elsewhere.

Free Fall of Only Four Inches

In fact, the impact, as measured by recorders atttached to

FIG. 8—OBELISK IN POSITION
Note Target (Small White Spot) At Center of Gravity

the obelisk, was almost imperceptible—no more than that which would be caused by a free fall of only 4 inches. The falling mass of 11,000 tons settled so gently into place that, apparently, it would have been perfectly safe for a person to ride on the obelisk during the entire period of its fall. No one asked for that privilege, however.

To a considerable extent, the effectiveness of the water cushion depended on the accuracy with which the obelisk fitted the contour of the rock stream bed, because the greater part of the retarding effect was caused by water being accelerated and removed at extremely high velocity during the last few feet of motion. It is probable that water was moving out from under the obelisk at velocities as high as 600 feet per second just as the mass approached its final position.

An interesting feature of the placing of the obelisk was the complete destruction of the forms left on the face toward the channel. The timbers were split and broken into small fragments by the water moving at high velocity out from under the obelisk. Some of the timber fragments were thrown a distance of 300 feet. The photograph shows the movement of the displaced water.

Motion Pictures of Tipping Obelisk

Several moving picture cameras were used because it was desired to obtain a record of the spectacular features of the event as well as to record the scientific phases. One of the cameras was slow motion with 128 exposures per second. The others were standard cameras. A seconds pendulum was placed in the field of view of one of the standard cameras in order to time the fall accurately, and a painted target, shown in the photograph, was placed on the downstream face of the obelisk, to mark the center of gravity.

Completing the Cofferdam Seal

The final sealing was quickly and economically accomplished. The procedure was, first, the closure of the gaps at the ends of the obelisk with 12 by 12 inch timber stop logs; second, the filling of the spaces with rock-filled cribs decked with concrete; and third, the sealing of the obelisk along the bottom by placing coarse rock, fine rock, sand, and clay, using 20-yard side-dump cars. Shortly after, the trestle was extended and the needle dam erected. One of the photographs shows this stage of the work.

If an ordinary cofferdam had been used its construction could not have been safely undertaken until late in November, when the annual low water period on the Saguenay river begins and the work of building such cofferdam, sealing it and the placing of 100,000 cubic yards of concrete in the river section of the main dam would have had to be completed by the latter part of the following March in order to allow about one month's time for the concrete to set before the April-May flood would fill the reservoir.

The obelisk method of cofferdaming the stream enabled the building of the obelisk in advance, and at a convenient time, so that it could be tipped into the river at the opportune time, i.e. on July 23, 1930, and the main dam was closed on December 21, 1930, or at least 100 days earlier than would have been possible had ordinary cofferdam methods been used. Furthermore, the obelisk method enabled the work of closing the dam and particularly the preparation of the foundation in the riverbed section under warm weather conditions instead of sub-zero conditions that would have obtained if ordinary methods had been used. Measured conservatively in dollars the obelisk method resulted in a saving of approximately $700,000.

All Told, a Most Satisfactory Method

From every angle, the results obtained with this hitherto untried method of closing and completing a difficult cofferdam have been very satisfactory. All the engineers connected with the project have full confidence in the workability of the scheme and will use it again when occasion demands.

The idea of building a temporary diversion dam by the novel methods described in this article, was conceived by James W. Rickey, M. Am. Soc. C. E., Chief Hydraulic Engineer of the Aluminum Company of America, Pittsburgh, and was carried out under his direction. This method of construction has been patented.

PRESIDENT: Is there any one here who would like to ask Mr. Rickey any questions about the formidable demonstration he has given us here in connection with the construction of this dam? I would like to ask Mr. Rickey how far north of Chacoutimi is this work.

MR. RICKEY: About ten or twelve miles.

PRESIDENT: Has anybody else anything to add? We

would like to hear from Mr. Snyder, First Vice-President of the Club.

MR. F. I. SNYDER: The Railway Club of Pittsburgh is a forum for the discussion of subjects of interest to the railroad world. Certainly we have had such a discussion tonight. This symposium presented by the officers of the Aluminum Company of America has been very interesting. The technical side of the process of manufacturing aluminum by Dr. Faragher, and the account of the efforts to apply it to transportation uses by Mr. Woolley, and those very interesting pictures and the description of the work at Chute a Caron, by Mr. Rickey, have been especially interesting. I would like to move a rising vote of thanks to these gentlemen as an expression of our appreciation.

The motion prevailed by unanimous vote.

There being no further business, adjournment was had to the tables at 10:25 P. M.

J. D. CONWAY, Secretary.

In Memoriam

A. P. WESTON

Joined Club September 25, 1924

Died April 26, 1932

GILBERT E. RYDER

Joined Club February 28, 1913

Died May 17, 1932

RESERVED

OFFICIAL PROCEEDINGS

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SCIENCE IN ACTION

By DR. E. R. WEIDLEIN, Director, Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa.

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OF

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Organized October 18, 1901

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Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING
SEPTEMBER 22, 1932

The meeting was called to order at the Fort Pitt Hotel at 8:00 o'clock P. M., with President John E. Hughes in the chair.

There were 169 registered in attendance, as follows:

MEMBERS

Aaron, Paul S.
Allen, Harvey
Babcock, F. H.
Balzer, C. E.
Beam, E. J.
Berg, Karl
Buffington, W. P.
Burgham, M. L.
Campbell, J. E.
Carson, John
Christy, F. X.
Conway, J. D.
Coombe, A. B.
Cotter, G. L.
Courtney, J.
Dalzell, W. E.
Dambach, C. O.
Davis, Charles S.
Diven, J. B.
Durkin, J. E.
Emery, E.
Emsheimer, Louis
En Dean, J. F.
Endsley, Prof. Louis E.
Erickson, L. S.
Evans, David F.
Flinn, R. H.
Fox, George W.
Frauenheim, A. M.
Frauenheim, P. H.
Fults, J. H.
Furch, George J.
Gardner, George R.
Gatfield, Phillip I.
George, R. H.
Gilg, Henry F.
Glenn, J. H.
Goda, P. H.
Graham, Charles J.
Hackett, C. M.
Haller, Nelson M.
Harper, G. C.
Hilstrom, A. V.
Holmes, E. H.
Hughes, John E.
Johnson, J. W.
Johnston, H. F.
Keller, Ralph E.
Kelly, L. J.
Kruse, J. F. W.
Kummer, Joseph H.
Lanahan, Frank J.
Lanahan, J. S.
Landis, William C.
Leban, J. L.
Leet, C. S.
Loeffler, George O.
Longdon, C. V.
Lowry, William F., Jr.
Lunden, Carl J.
Mayer, L. I.
Millar, C. W.
Miller, J.
Misner, George W.
Mitchell, F. K.
Mitchell, W. S.
Montague, C. F.
Morgan, A. L.
Morgan, Homer C.
Moses, Graham Lee
Myers, Walter H.
McElravy, J. W.
McIntyre, R. C.
McKenzie, Edward F.
McKinley, A. J.
McKinley, John T.
McMillan, A. P.
McNelty, A. P.
Nagel, James
Newell, J. P., Jr.
Orchard, Charles
Pringle, H. C.
Posteraro, S. F.
Redding, R. D.

Renshaw, W. B.
Ryan, D. W.
Ryan, Frank J.
Sattley, E. C.
Schmitt, Raymond F.
Severn, A. B.
Shannon, D. E.
Sharp, H. W.
Smith, J. Frank
Stamets, William K.
Stark, F. H.
Stevens, L. V.
Stevens, R. R.
Stillwagon, C. K.
Stoffregen, Louis E.
Sutherland, Lloyd
Thomas, H. N.
Thomas, T. T.
Thornton, A. W.
Trax, L. R.
Van Blarcom, W. C.
Vollmer, Karl L.
Walther, G. C.
Weaver, W. Frank
Welch, E. M.
Wheeler, C. M.
Wikander, O. R.
Wildin, George W.
Woods, Joseph
Wyke, J. W.
Yarnall, Jesse
Yohe, C. M.
Young, F. C.

VISITORS

Bickett, M. A.
Brown, E. L.
Carruthers, G. R.
Dunham, C. W.
Dunlap, A. G.
Ellis, W. O.
En Dean, H. J.
Ferguson, R. G.
Forger, F. A.
Forsythe, J. W.
Frauenheim, A. M., Jr.
Frauenheim, J. E.
Friend, Edward F.
Gardner, G. R., Jr.
German, H. J.
Goldberg, Milton M.
Herley, J. E.
Herron, John S.
Jablow, Charles
Jablow, Warren
Klassen, F. G.
Kreps, Edward C.
Lenk, Rudi
Lewis, B. W.
Lewis, S. B.
Lundberg, Abe M. J.
MacDonald, H. C.
Manzey, Paul H.
Mateer, W. H.
Marx, Gilbert J.
Miller, George
Mitchell, Paul S.
Mock, J. C.
Moon, Matthew M.
Morgan, C. J.
McCabe, Dr. A. D.
McDonald, John
Orr, H. S.
Orr, Leighton
Reynolds, Daniel
Ross, B. J.
Schrontz, S. B.
Scofield, W. Y.
Smith, F. C.
Stoecker, W. O., Jr.
Terkelsen, B.
Triem, W. R.
Tripp, W. C.
Watts, G. S.
Weidlein, Dr. E. R.
Wheatley, Albert
Whitney, E. F.

The call of the roll was dispensed with as the record of attendance is given on the registration cards.

The reading of the minutes of the last meeting was dispensed with as the Proceedings have been printed and distributed to the members.

SECRETARY: We have the following proposals for membership:

Graham, H. E., Assistant to President and General Traffic Manager, Jones & Laughlin Steel Corporation, Pittsburgh, Pa. Recommended by J. D. Conway.

Kern, Roy S., Chairman, Coal, Coke & Iron Ore Committee, C. F. A., 836 Wabash Building, Pittsburgh, Pa. Recommended by W. P. Buffington.

Shay, H. J., Machinist, Pennsylvania Railroad, Room 306 Federal Street Passenger Station, N. S., Pittsburgh, Pa. Recommended by F. X. Christy.

PRESIDENT: In accordance with our By-Laws, these names will be referred to the Executive Committee and upon approval by that Committee the gentlemen will become members without further action of the Club.

SECRETARY: Since our meeting in May we have the following deaths to report: Julian Kennedy, Consulting Engineer, who was an Honorary member of the Club, died May 28, 1932; J. E. Patterson, Retired Locomotive Engineer, Union Railroad, died January 30, 1931; T. J. Martin, Assistant Trainmaster, Pennsylvania Railroad, died July 2, 1932, and Charles R. Long, Jr., President, Charles R. Long, Jr. Company, died August 12, 1932. Mr. Long was a charter member having joined the Club in November, 1901.

PRESIDENT: An appropriate memorial minute will appear in the next issue of the Proceedings.

In accordance with our By-Laws it is my privilege to appoint tonight a Nominating Committee and name as members of that Committee, Mr. Karl Berg, Chairman; Mr. F. K. Mitchell and Mr. L. V. Stevens. The Committee will please retire and report later in the evening.

If there is no further business, we will turn the meeting over to the Chairman of the Executive Committee, Mr. Frank J. Lanahan and his children.

MR. FRANK J. LANAHAN: My dear Friends, it is a source of real delight to me to have you meet my little pals from the classic precincts of McKees Rocks. These youngsters are daily visitors at the office and they and I have become quite intimate. Pleasure and amusement have they afforded me for many years, despite the charitable feature of helping them over

many rough spots on their financial highway and lifting them, if only for an hour or two a day, from the environment in which circumstances have placed them.

They are here through the kind and thoughtful invitation of our delightful and genial associates,—John E. Hughes, Sam Lynn and Karl Berg, who have done us the honor of visiting the class on different occasions. These gentlemen had planned to surprise "yours truly" in bringing the children here for your entertainment unknown to me, but it was much like trying Hamlet without the melancholy Dane, and so they had to let me in on the secret. Of course, I was just as pleased with their thoughtfulness.

And now, gentlemen, here are some of the little kiddies of my so-called "scout class". Due to the limited space, it was not possible to bring them all, but these represent possibly a third of the entire class. (Here more than 100 little boys and girls ranging in age from two years to fourteen, marched in, and the regular procedure of the daily class at the Fort Pitt Malleable plant, was started.)

As is the daily routine, the class was opened with the questions, "Anyone swearing? Anyone playing on the railroad tracks? Anyone fighting?" To each in turn, came the answer loud and clear, "No, Mr. Lanahan." The class motto was next recited:—

"If to you a kindness is shown,
Pass it on,
It wasn't meant for you alone,
So pass it on.
Let it travel down the years,
Let it dry the mourners tears,
Until in Heaven the deed appears,
So pass it on."

Following in the usual order they were asked, "What does the class stand for", and the answer came, "Reverence, Patriotism and Service". "Reverence to God, love of our country and service to our fellowmen". Next came the nightly distribution of the nickels by the Misses Ryan, each child receiving one, and in these days, we are told they are eagerly grasped at home to buy bread. The children then in turn, both individually and collectively, recited their little bits of philosophy, patriotism and humor, sang little songs, danced, etc. Next they were asked their "good turns" of the day, it being a requisite of attendance, to do some good each day, either at home or to

one another. "Captain" Bill Duggan came forth to give his little baseball rhyme, using his ideal gentleman, as the hero of his story, Mr. Curtis M. Yohe.

In explanation of my little class, let me say that some fifteen or seventeen years ago, it was started with just a handful of youngsters clamoring about my automobile for a ride, and those who were denied the pleasure, by reason of limited capacity of the car, were appeased by a bright new penny, and from that day to this, they have never missed an evening, and the crowd has grown until it now numbers more than 300, the father and mother of some of these little ones here, having been among those who were charter members of the class.

Sorry am I to tell you that there is not one child here in whose home a pay envelope has been received for many months; in fact, many of their fathers have been among the unemployed for more than two years and as a consequence, distress and poverty, which even in good times made itself felt, has brought misery and starvation, and not a few of them have been evicted from their homes due to lack of resources to take care of the rental. There is no restriction whatever in the youngsters gaining admittance to the class, in fact, the children of our own Fort Pitt employees are greatly in the minority. As you railroadmen are naturally interested in knowing those who belong to the transportation family, I will ask those whose fathers work for the railroads, to kindly raise their hands. (Quite a few responded and there was applause from the audience.)

As the special car will soon be outside to take the kiddies back to their homes—under the protection of Mr. D. E. Shannon, a member of the Railway Club, who so kindly looked after them coming up, they will bid you all "Good Night", with the little verse that marks the closing every evening:—

"Sail on, thou Ship of State,
Sail on, thou Nation proud and great,
Humanity with all its fears,
With all its hopes of future years,
Hangs breathlessly on thy fate."

The children were then marched from the platform to the exit, and in passing through each was made the happy recipient of a souvenir of candy and a prize package, and went home their little hearts made joyful with balloons, whistles, puzzles, tops, dolls, bracelets and many other playthings, while their impressive little minds shall never forget the kind reception and cour-

tesy of the members of the Railway Club, and their first visit to a real hotel.

PRESIDENT: We have now come to the paper of the evening. We are honored tonight in having with us Dr. E. R. Weidlein, Director, Mellon Institute of Industrial Research, University of Pittsburgh, who will address the Club on—"Science in Action". Dr. Weidlein addressed this Club in 1929 and we are glad to have him here again tonight—Dr. Weidlein.

SCIENCE IN ACTION

By DR. E. R. WEIDLEIN,
Director, Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa.

In 1900, the number of organizations devoted to research work in the United States could be counted on the fingers of one hand. There are at the present time over fifteen hundred well established research organizations, and during the past year industry spent around $200,000,000 for the support of these research laboratories. It is being made clear to American manufacturers that scientific research, properly planned, and systematically carried out under conditions favorable to productive effort, is remunerative to them and actually constitutes an investment. In the present period of trade depression, industrial research is being carried out extensively—in many branches of manufacture, as though no subnormal condition exists. The chemical industry in particular is in a much stronger position to look after itself today than it was during the previous slump—a condition that is due largely to the extensive use in the intervening years of the services of well-trained, wisely managed research staffs. A large number of progressive manufacturers are making the depression an opportunity for intensive production and merchandising research. The present drop of one-third in the average worker's purchasing power will inevitably force further readjustments in the cost of living. The urgent necessity of reducing costs and of turning the tide of buying has spurred mail-order houses, chain-store organizations, and great department stores to try through research to cut costs and prices and to secure greater value to place before the public. One hundred and twenty-five million consumers have been educated to the highest material standard of living that the world has ever seen; and yet our standard of living is being forced

down when about us we observe all the material factors necessary to a rapidly advancing scale of life. The increasing deprivation of what the people have grown accustomed to believe is their standard of living will lead to great dissatisfaction and demoralization. Yet, the scientists are effectively prevented from maintaining or advancing our standards of living, due to the inadequacy of our economic organization. Scientific developments require large capital expenditures, extending over a period of years, and under our present system of taxation the returns are greatly inadequate for the risks which are encountered.

As early as 1890, economics showed the need for and the value of industrial research. Yet the science of economics did not keep pace with the research developments. The colossal failure of the twentieth century is in economic organization. We are attempting to operate a twentieth century economic machine on the basis of an eighteenth century economic philosophy.

The present stage in our industrial development calls for original thinking, for daring and adventurous thinking. There are thirty thousand scientists in the United States, who are trained for just this kind of thinking. These scientists, if given the opportunity, will provide the physical basis for a standard of living immeasurably superior to our present one. Fortunately, the individual is a continually developing organism. In the nature of things, there is no possibility of stopping at any determined level. It would seem further that perhaps our economic outlook is suffering from the defect of failing to recognize this difference and being static. There is but one conclusion to draw, and that is—that new developments are the life of economic prosperity. If this is so, then without a steady flow of new developments, prosperity cannot return or be maintained.

Consider what the economic conditions of this country would be had we had no new developments. The creation of the radio, electrical, automobile, aeroplane, chemical, metal, textile and other industries too numerous to mention are typical examples, and these industries are still in their infancy. The creation of these new industries were the result of the great team work between the pure science research worker, the industrial scientist, and the industrialist. Industrial research is looked upon by numerous companies as an absolute necessity for continuing business success. A company that is making and marketing a research product with commercial success keeps on with research in the same field, so as to safeguard its invest-

ment and to maintain its leadership. Indeed, in addition to its other functions, research is insurance against obsolescence of processes and products. The attitude of the more progressive type of manufacture in this country recognizes that their products must be improved year by year, and that there is no economy in making them so that they will last longer than the period when new improvements in the field will demand that they be discarded.

Industries that fail to recognize the competition of the future, and who are not taking advantage of this golden opportunity to modernize their plants, will find with the return of good times that things have changed—and very much to their disadvantage. A period of depression rids the industries of many poor plants, processes, machines, products, as well as personnel. If we were permitted to reveal the activities of various industrialists at the present time, their competitors would have much more to worry about the future, than they have at the present time. The automobile industry has clamped down on many of its specifications in order to save costs, and as a result one company now supplies 90% of a very important product, because it is the only one capable of meeting the specifications, and in doing so it has reduced its own rejections from 16% to the last month within zero to 2%, without increasing production costs. Another large company recently passed into receivership and the receivers requested the court for permission to continue the research program, which had only been in progress two years, as that seems to be the only future for this particular industry. A large department store President explained to his board of directors when they were considering reductions throughout the store that the research department was the only productive organization, and consequently he was authorized to increase its personnel, which was a highly constructive move.

A new synthetic resin product made its appearance on the market in February, 1931, in a highly competitive field, and by November, this new organization showed black figures and its business has more than doubled since January 1, 1932.

Robertson-Bonded-Metal is the result of extensive research that has led to the production of a laminated metal-felt material in which felted materials are cemented to steel with heat and pressure, utilizing metals as adhesives. The composite laminated material, the outer surfaces of which are suitable felts, is then saturated with any desired saturant chosen with refer-

ence to the corrosive condition to which the metal is to be exposed in service. Paint, lacquer and resin films superimposed on the saturated felt give not only added protection but also desired attractiveness of appearance in the finished product. Owing to the fact that it is possible to choose between a number of felts and felt saturants to stand against various corrosive conditions, this new protected metal promises flexibility in providing corrosion resistance. The ductile nature of the metal bond between felt and steel makes it possible to subject this material to forming operations such as shearing, bending, corrugating, rolling and mild drawing without destroying adhesion between felt and steel. By selecting asbestos felt together with fireproof saturant a fireproof material results, while an increased insulating value over that of bare metal is obtained with any combination of felt and saturants. It is also claimed that this new material of construction has the strength of metal with none of the attendant "ring" and reverberation of bare metal.

R-B-M is said to have a promising field of application not only in the building field, but also in the manufacture of paneling for various purposes, pipe-line protection, novelties, etc. The cost, it is reported, will be commensurate with the degree of protection desired.

The automobile has completely revolutionized the paint and varnish industry, because of the requirements for a better finish and one that can be applied in a short period of time. The result is the manufacture of nitrocellulose lacquers, and the development of new synthetic gums and solvents. This advance, in turn, has created two entirely new industries within the last ten years. One of these industries is located in the corn-belt area of Indiana and Illinois. Through scientific research in the field of biochemistry, the corn is treated with a micro-organism that produces these necessary lacquer solvents instead of the more familiar solvent, ethyl alcohol. The second of these industries depends upon two mineral products, natural gas and crude petroleum, for its source of raw material. This industry is especially close to us, as it originated and was nurtured into adolescence in the laboratories of Mellon Institute. The results of this research have made available in large quantity and at low cost a variety of commercially valuable organic chemicals distinct in origin as well as in application from the synthetic chemical products previously on the market.

By-Products Open New Markets

A principal product of these efforts is ethylene glycol, which has come into commerce for the first time, after having been known since the early days of chemistry only as a curiosity. Ethylene glycol is now widely used in explosives manufacture and as an anti-freeze material for automotive engines; it is also finding numerous new uses to supplement the inadequate supplies of glycerin and is serving purposes entirely new in the arts. The ethers of this glycol are ideal solvents for nitrocellulose lacquer, and in the rapidly expanding lacquer industry they are introducing indispensable qualities.

The pure hydrocarbon constituents of natural gas have also found many valuable and interesting uses. For example, ethane, propane, isobutane, and normal butane have been found to possess special physical properties that make them desirable as refrigerating gases. Commercial propane, distributed in cylinders, is a fuel gas with widespread application in the household, laboratory, and factory. Thus ever more products are being made from natural and other gases, and it is apparent that an industry of large proportions is being constructed on the unique fundamental research that has been conducted in this field.

The electric illumination, electrochemical, telephone and radio industries have been developed from their basic inventions to important places in our present industrial organization in a period of less than fifty years. In each there is striking evidence of the inter-relation of the "cycle of research" with the various stages in the evolution of the industry. It is significant that the time lag in the development of these industries has been greatly reduced by systematic scientific research. What happens when research is undertaken in older industries—in the iron and steel industries, for example, which are of the oldest in recorded history? The steel industry for hundreds, if not thousands of years was an art, and yet within less than fifty years it has felt the influence of research and has experienced a greater development in that period of five decades than in all the centuries that went before.

Studies Save Fuel

Another very important manufacture that has been due mostly to chemistry is the by-product coke industry. Modern civilization rests largely upon coal and iron, which, in turn, are linked by coke. In making coke, other materials, termed by-products, are had, from which modern chemistry has developed

thousands of very useful chemicals, fertilizers, explosives, disinfectants, perfumes, roofings, wood preservatives, medicines, and practically all the dyes used in the textile industry.

Naturally, one of the main subjects of research is coke itself. Not many years ago the coke made in the wasteful beehive oven was preferred by the average blast-furnace man. Now it is generally recognized in American practice that by-product coke gives superior results. This has been due not merely to a change of attitude on the part of the blast-furnace man, but to a real improvement in the quality of the by-product coke, and research is in progress for further improvements in blast-furnace practice. Frequent investigations have to be made in relation to producing the best possible coke from new types of coal. These coals must be studied both in the laboratory and in the plant, in order to determine the conditions best adapted to each. The conditions satisfactory for making coke, from one kind of coal may be quite different from those necessary in dealing with a different type. The results of these investigations are of the utmost importance from the standpoint of fuel economy and conservation.

Smoke Means Wasted Fuel

Coal is one of our most important raw materials, and offers many opportunities for research work from the points of view of both the chemist and the engineer. In the field of engineering and physics, heat insulation in all of its varied aspects has a great future, since it has recognized value in reducing working expenses and specifically is of very material aid in effecting fuel economy. It is known generally that the losses from bare pipes and boilers are considerable, but the real magnitude of these losses is little appreciated. The fact that the loss from 1,000 sq. ft. of exposed surface at 100 lb. per sq. in. steam pressure represents over 300 tons of coal annually is a sufficient justification for the serious consideration of the subject. Valuable research has been conducted in this field during the past few years, which has placed the industry on a scientific basis and has created more efficient, durable and serviceable insulation. The proper amount of non-heat-conducting material which should be applied to any heated surface will be that at which the cost of an increment of the covering will just balance the savings that will be accomplished by the increment. All insulation companies are now in a position to supply such information as a result of careful scientific research work.

One of the biggest problems that we are facing is the smoke nuisance. Smoke does not have a single saving grace. It is injurious to health. It is expensive in that it means fuel waste, high laundry bills, defacement of expensive buildings and lessened working capacity. Experts declare that throughout the United States smoke costs each inhabitant $16 annually. Smoke is not, as it was once thought to be, the inevitable consequence of industrial and commercial activity. Correctly designed and operated plants do not smoke.

The remedy for the industrial smoke problem is to provide such engineering oversight of new installations as to insure a non-smoking plant to begin with. It may mean changes in building plans, a larger investment, a greater responsibility of management, a more intelligent operation, but these things are the price of clean air. It is of little use to complain of smoky stacks and allow new ones to be added daily.

Cellulose Gives Many Products

Along with coal, we have another most important raw material in cellulose, also a vegetal product. An enormous chemical industry has been constructed on the use of this raw material, including lacquers, explosives, celluloid, sausage casings, and last, but most important, rayon. Rayon, born of chemistry, is now an important factor in the textile field. Many manufacturers are at present making all-rayon fabrics, while others are combining rayon with cotton, silks or wool. About one-fifth of the hosiery produced today contains rayon, and millions of yards of cloth are being made annually, either wholly or in part of rayon. Cellulose is also the basis of another new industry developed in the chemical laboratory, the production of artificial sausage casings. Two hundred miles of these casings are now being made daily to cover our well known "hot-dogs" and other meat products. As is so often the case in the synthetic production of a new product, new properties are introduced which give added value to the material. It is possible to remove these synthetic casings from the meat—after the stuffing process—and the finished wiener is sold as a skinless product. This company has increased its business 40% in 1932 to date.

Someone has said, "the sugar industry without the chemist is unthinkable." This statement is indeed correct, for chemistry has been the main factor in the development of sugar technology. Agriculture, manufacture, refining and uses have de-

pended upon chemistry in this important industry; and the many processes the chemist has worked out have brought better, cheaper sugars and growth to all branches of the sugar producing and consuming manufactures. Researches are now being conducted to utilize sugar as a raw material for a new chemical industry.

Food Supplies Increased by Research

The manufacture of glucose and grape sugar, or the corn-products industry, was built upon a notable discovery of a chemist, namely, the conversion of starch into reducing sugars. Since then—over a century ago—the chemistry and chemists have been inseparably and intimately connected with this great industry. Chemical research has shown how to make profitably corn syrup, starches, dextrins, many gums (for adhesive purposes), various sugars, gluten feed, oil, oil cake, and other products from corn. The chemist, in fact, has found the way to manufacture over one hundred useful commercial products from this raw material, the fruit of a majestic, wondrous plant.

Throughout the food industries, research has been devoted to the problem of preservation. Cold storage, which has been developed scientifically, is now a vast industry. In the canning industries sterilization by heat, to kill the germs of decay, is the standard method of preservation. Vacuum drying, a speedy process of desiccation, is being applied to fruits, vegetables and milk. Packing in carbon dioxide to preserve sensitive flavors, as of shredded cocoanut and of nutmeats; the process of quick freezing—whose useful application rests on late advances in refrigeration engineering—and the use of solid carbon dioxide, to maintain low temperatures in food packages, are other recent improvements in this field. Further developments will some day make fruits, fish and meats of even the remotest lands available in wholesome condition at the largest centers of population.

The study of the corrosion of metal vessels and containers by foods is a very important subject. An extensive study of pasteurizing or boiling milk in aluminum has shown the metal to be entirely without specific effect in the destruction of vitamin C, the most labile of these essential accessory food substances, the vitamin. Another research was concerned with the absorption of aluminum from the alimentary tract. Analysis of the tissues of animals which had consumed food containing as much as a hundred times the amount of aluminum which would come from utensils by corrosion showed the naturally present

aluminum to be only very slightly increased. Many of the animals subsisted on the aluminum-containing diets continuously for 18 months. If the aluminum of the diet was increased to exceed the total phosphorous content, a form of rickets developed. It was proved that iron produced a similar result if fed in an equivalent dosage. The rachitic effect of either iron or aluminum was prevented simply by adding phosphate to the diet, demonstrating the rickets to be due to a phosphorous deficiency rather than a specific effect of iron or aluminum.

The extent of corrosion of aluminum utensils by foods in the cooking process has been shown by comparative analysis of a variety of foods cooked in glass and in aluminum. The results indicate that between the "aluminum by corrosion level" and the "phosphate exceeding rickets-producing level" there is a safety factor of about one hundred. Consequently health authorities now regard aluminum utensils as perfectly safe for use.

How We Sleep

Equally important to the subject of our food supply is that we obtain the proper amount of sleep. This subject is now receiving scientific investigation. The work at the present time is concerned chiefly with postural changes during sleep.

The results show that a given individual may have a repertoire of a dozen or more sleeping postures that differ grossly from each other. On a typical night he resorts to nearly every one of them one or more times, unless he is physically restrained. Some of these poses are favored by nearly all sleepers, but most of the others may be divided into two groups, one of which is favored by one class of sleepers and avoided by a second class, and vice versa. It is normal for an adult to make from twenty to forty or more gross changes of posture on a typical night while typical children shift more often. The least active sleepers that were found were a group of unmarried women of college age. Each pose appears to be well chosen, if considered with reference to the irritation that was set up by tenure of other poses recently taken. Poorly designed bedding equipment may limit the variety of postural changes without decreasing the number. This effect is far more important for some sleepers than for others. In many instances no important effect was found. If the sleeper was provided with a good, upright coil bed spring and a good interior-spring mattress, no restful poses appeared to be discriminated against. Under the experimental

conditions, the sleepers normally dispensed with bed coverings and used a bed chamber that was held at a temperature of $80 \pm 2^\circ$ F. They also lay in the direct illumination of a 150-watt lamp. Under these conditions, they stirred less frequently than under normal conditions. In particular, light quickly ceased to disturb their rest or to bring out gestures of protection.

The afternoon rest of children is much quieter than nocturnal rest. This fact, coupled with the finding that nocturnal sleep is hardly affected by the afternoon nap, while the children tend to awaken at nearly the same hour no matter when they were put to bed, is considered important. It indicates that whatever rest may be obtained in the afternoon is clear gain, and that the afternoon nap is the preferable way of getting any extra rest that may be required.

This type of a research program indicates the present attitude of a great many of our large corporations in their desire to support fundamental research work.

The great value that has accrued to industry through pure scientific research should not be lost sight of during these difficult days, as such information is the basic raw material for future development and progress.

PRESIDENT: You will all agree with me that we have had a splendid address and I believe we might find time to discuss it a little further, and I am sure Dr. Weidlein would be willing to answer any questions from the floor that might be asked in connection with his address. Will be glad to hear from anybody.

MR. C. O. DAMBACH: Mr. Chairman and fellow members of the Railway Club of Pittsburgh. I know all of us who had the pleasure of listening to Dr. Weidlein four years ago anticipated a treat tonight, and have not been disappointed. Some of us, learning that we were to be addressed by a Doctor of Science were fearful that his language might be over the head of the average layman, but the Doctor's talk tonight was such that it should have been readily understood by the youngest of Mr. Lanahan's pupils. Personally I do not remember of an occasion when we had a speaker who had the rare faculty of being an orator in addition to an authority on the subject about which he was addressing us. I know we have all enjoyed this interesting and instructive talk and move that we express our thanks by a rising vote. Motion prevailed by unanimous rising vote.

MR. CHARLES ORCHARD: I would like to move you, Mr. President, that a vote of thanks be extended to Mr. Lanahan for the very interesting entertainment given us by his troup from McKees Rocks. Motion seconded and carried by rising vote.

PRESIDENT: We have a large number of visitors with us tonight and I extend you all a cordial welcome. One of our visitors here who radiates sunshine wherever he may be, whom I am glad to call upon, and I present to you Mr. John S. Herron, President of City Council, Pittsburgh.

MR. JOHN S. HERRON: Mr. Chairman and Gentlemen: I do not feel as though I should say anything tonight, because I came here to be entertained by Mr. Lanahan's children and I certainly have enjoyed it. After the display that they gave us tonight, I can well imagine that there are great possibilities for these children—perhaps some Railroad Presidents are among this group. They are being trained right, and I am sure will give a good account of themselves in the future.

As we look back, most of us have seen a great many things that have been talked about and dreamt of turn out to be actualities. No doubt that the future will solve many more for us. To me, it seems but a short time ago when we were working on the Frick Building when there wasn't a single motor truck in the City of Pittsburgh and all the hauling was done by horses and it was quite a common sight to see a driver with a long whip guiding six or eight teams. We can remember the first automobiles and we can remember when Charlie Graham had his first automobile—one cylinder, and then two cylinders. Today, we accept the modern automobile as just one of the things that happen and forget all about the grief that went before.

Only a short time ago, we had an inspection of the Smithfield street bridge and found that it needed reinforcing badly and we are now arranging with the Aluminum Company of America to replace the floors and reinforce and change the beams with aluminum which will lighten it by many tons and yet will increase the carrying capacity by over 15 per cent. We have been told that this is the first time aluminum has been used for this purpose, so Pittsburgh takes another step forward, thanks to the scientists and capitalists who make these things possible.

I enjoyed Dr. Weidlein's talk very much tonight. He pre-

pared us for a great many things that are about to come and I am sure we have all profited by our visit here, and Mr. Chairman, I hope that it will not be long until the scientists are able to devise a way to put up a ham sandwich in capsule form, so that we will not have to worry about carrying lunches. I thank you.

PRESIDENT: Thank you Mr. Herron. It is getting late, but we have with us Mr. B. W. Lewis, Vice-President and Cashier, Mellon National Bank, and we want to welcome you to this Club. Would you care to say a word to the Club members?

MR. B. W. LEWIS: I am not a speaker and did not come here with any thought or intention of making any remarks. I came here to see the children act and to hear Dr. Weidlein speak, and have enjoyed both very much.

PRESIDENT: Thank you Mr. Lewis. We will be glad to have you come back again. I would like to introduce to this Club Mr. Charles J. Graham, Vice-President, Pittsburgh Screw & Bolt Company. Please stand up Mr. Graham so we can look you over.

MR. CHARLES J. GRAHAM: I just want to say a word to this party tonight. The entertainment I have listened to has been an inspiration. It is effort such as has been put into this by Mr. Frank J. Lanahan that makes the world a better place in which to live and better people to live with. It reminds me of a little piece of poetry that made a great impression on me, many years ago:

The inner side of every cloud
    Is bright and shining;
So I therefore turn my clouds about
And always wear them inside out
    To show the lining.

PRESIDENT: Shall we now hear from the Nominating Committee? Mr. Karl Berg, Chairman, we are ready for your report.

MR. KARL BERG: I have the names written down and, with your permission, will ask the Secretary to read them.

FOR PRESIDENT: F. I. Snyder, Vice-President and General Manager, Bessemer & Lake Erie Railroad Company.

FOR FIRST VICE-PRESIDENT: C. O. Dambach, Superintendent, Pittsburgh & West Virginia Railway Company.

FOR SECOND VICE-PRESIDENT: R. H. Flinn, General Superintendent, Pennsylvania Railroad.

FOR SECRETARY: J. D. Conway.

FOR TREASURER: E. J. Searles.

EXECUTIVE COMMITTEE: (Eleven to elect) Frank J. Lanahan, Chairman; A. Stucki, Samuel Lynn, D. F. Crawford, F. G. Minnick, G. W. Wildin, E. J. Devans, W. S. McAbee, E. W. Smith, Louis E. Endsley, John E. Hughes.

SUBJECT COMMITTEE: (Two to elect) One year, H. W. Jones; Three years, D. W. McGeorge.

RECEPTION COMMITTEE: (Two to elect) Three years, Donald O. Moore, G. M. Sixsmith.

FINANCE COMMITTEE: (One to elect) Three years, F. X. Christy.

MEMBERSHIP COMMITTEE: (Three to elect) Three years, E. Emery, E. A. Rauschart, Herbert J. Watt.

PRESIDENT: Are there any further nominations? If not, what shall be done with this report? Moved and seconded that the nominations be closed. All in favor of motion, say aye, contrary, no. Carried. Election will take place at the October meeting and ballots will be sent out between now and that meeting.

Mr. F. H. Stark has not been here for sometime and as he is one of our old past-presidents we would like to hear from him. Mr. Stark.

MR. F. H. STARK: Mr. President and members of our Club, I am surely pleased to be here. To meet old friends and learn to know new members is a pleasure, I assure you.

The personnel of our Club changes very materially in the course of a few years. I observe by our Proceedings that quite a few past-presidents have passed to their reward. The first two presidents of our Club and six others that followed me in the chair have died, yet some of us pioneers are spared to help carry on.

I want to congratulate the speaker of the evening for the interesting address he gave us. During our present depression,

some of us will learn how to utilize our leisure time and since Professor Weidlein and his associates are to make it possible to produce all our needs with much less effort, we will be prepared to adjust ourselves to a work-less experience.

I compliment our good friend, Frank Lanahan. He has given us a fine demonstration of what can be done for the young boys and girls. Judging by their program tonight, I am sure many of them will be a credit to themselves and to their communities and who knows but what some day they may elect Frank Lanahan to the United States Senate.

PRESIDENT: Thank you Mr. Stark. Mr. Stark was President of this Club 1905-1907. Is there any further business to bring before this meeting?

SECRETARY: Mr. President: The Secretary always has something in the way of a request, oftentimes big. I haven't any troubles to present to the Club tonight except that we have gone through trying times, as you know, and we would like to have at least several hundred new names proposed for membership at our next meeting. It is a simple matter for the members of the Club, when they have some idle time on their hands to buttonhole some neighbor and invite him to attend one of our meetings and hear an address such as has been presented tonight, or during the past year. The Proceedings are printed and mailed to each member of the Club and this is all done for the nominal figure of $3.00 per year. I think if we would just take a little time out and elbow in with a friend or neighbor and explain to him what he gets for the $3.00 it would be time well spent. At our October meeting we would like to see a great number of new applications for membership presented.

PRESIDENT: If there is no further business, a motion to adjourn will be in order, and don't forget the luncheon at the left end of the room when the meeting is over.

On Motion adjourned.

J. D. CONWAY, Secretary.

RESERVED

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ANNUAL MEETING—ELECTION OF OFFICERS
LIST OF MEMBERS

OFFICIAL PROCEEDINGS
OF
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Organized October 18, 1901

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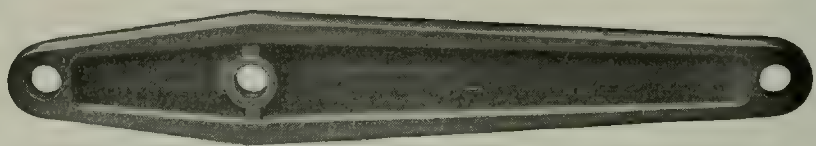

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Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING
OCTOBER 27, 1932

The Annual Meeting of the Railway Club of Pittsburgh was called to order by President J. E. Hughes at the Fort Pitt Hotel on Thursday, October 27th, 1932, at 8 o'clock, P. M.

Registration showed the attendance as 468 persons, 31 of which failed to sign their names.

MEMBERS

Aaron, Paul S.
Adams, Walter A.
Allderdice, Norman
Allison, John
Altsman, W. H.
Ambrose, W. F.
Ament, F. C.
Anger, C. E.
Anger, J. G.
Bald, E. J.
Barr, H. C.
Batchelar, E. C.
Beam, E. J.
Berg, Karl
Berghane, A. L.
Blest, M. C.
Bowery, Frank J.
Braun, O. F.
Brown, C. C.
Brown, C. L.
Buffington, W. P.
Bull, R. S.
Burel, W. C.
Burgham, M. L.
Burnette, G. H.
Callahan, F. J.
Campbell, J. E.
Campbell, J. T.
Campbell, W. T.
Carlson, L. E.
Carr, T. W.
Carson, John
Chilcoat, H. E.
Chittenden, A. D.
Christy, F. X.
Clark, C. C.
Clements, Frank C.
Conway, J. D.
Coombe, A. B.
Cotter, G. L.
Coulter, A. F.
Courtney, H.
Crawford, A. B.
Crenner, J. A.
Cromwell, H. T.
Cunningham, R. I.
Dambach, C. O.
Darrall, William G.
Daugherty, W. A.
Davies, Benjamin S.
Davis, C. S.
Deckman, E. J.
Dehne, G. C.
Dellmin, T. D.
Dempsey, P. W.
Dickinson, T. R.
Dunbar, H. F.
Durkin, James E.
Eagan, D. F.
Edwards, C. H.
Emery, E.
Emsheimer, Louis
Endsley, Prof. Louis E.
Falkner, A. J.
Farrington, Robert J.
Fink, Peter J.
Fisher, John J.
Fitz Simmons, E. S.
Flinn, R. H.
Frauenheim, A. M.
Frauenheim, P. H.
Freshwater, F. H.
Fry, L. H.
Fults, J. H.

Gaffney, Thomas H.
Gardner, George R.
Gardiner, J. E.
Gatfield, P. I.
Geddes, James R.
Gellatly, W. R.
Germak, George A.
Gilg, Henry F.
Glaser, J. P.
Goda, P. H.
Goff, J. P.
Grieve, Robert E.
Grove, C. G.
Guinnip, M. S.
Hackett, C. M.
Hall, Chester C.
Haller, Nelson M.
Hancock, Milton W.
Hansen, William C.
Harbaugh, C. P.
Harper, G. C.
Harper, J. T.
Herrold, A. E.
Hilstrom, A. V.
Holmes, E. H.
Honsberger, G. W.
Hoover, J. W.
Horner, William
Hughes, John E.
Hykes, W. H.
Irwin, Robert D.
Jenkner, Oscar
Jones, H. W.
Johnston, C. D.
Johnston, W. A.
Keller, Ralph E.
Kelly, J. P.
Kerr, C. R.
Klassen, Fred G.
Knapp, A. D.
Kroske, J. F.
Kruse, J. F. W.
Kummer, Joseph H.
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Lang, W. C.
Laughner, C. L.
Laurent, Joseph A.
Lawson, A. F.
Leban, J. L.
Lee, L. A.
Lewis, Herbert
Long, R. M.
Longdon, C. V.
Lowndes, T. H.
Lowry, William F., Jr.
Lundeen, Carl J.
Lynn, Samuel
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MacDonald, William C.
Maliphant, C. W.
Mason, S. O.
Masterman, T. W.
Mayer, L. I.
Meinert, Henry J.
Mercer, B. F.
Merscher, John
Miller, J.
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Mills, C. C.
Misner, G. W.
Mitchell, W. S.
Moir, W. B.
Montague, C. F.
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Morgan, A. L.
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Myer, Arnold
McAbee, W. S.
McCuen, J. T.
McGeorge, D. W.
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McNelty, A. P.
Nagel, James
Nash, R. L.
Newell, J. P., Jr.
Nieman, C. J.
Nieman, Harry L.
O'Leary, J. J.
Orbin, G. N.
Orchard, Charles
O'Sullivan, John J.
O'Toole, J. L.
Paisley, F. R.
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Paul, Lesley C.
Pollock, J. H.
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Rauschart, E. A.
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Renshaw, W. B.
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Rizzo, C. M.
Ryan, Frank J.
Sample, W. E.
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Thompson, Harry T.
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Tomasic, Joseph D.
Tomasic, N. M., Jr.
Toussaint, R.
Trautman, H. J.
Trax, Louis R.
Triem, W. R.
Tucker, J. L.
Van Vranken, S. E.
Van Wormer, G. M.
Walther, G. C.
Warfel, J. A.
Waterman, E. H.
Watt, Herbert J.
Weaver, W. Frank
Webster, H. D.
Welch, E. M.
Wheeler, C. M.
Wikander, O. R.
Wildin, G. W.
Wilson, J. M.
Winslow, G. W.
Winslow, S. H.
Wynne, F. E.
Yarnall, Jesse
Young, F. C.

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Ainsworth, J. R.
Allison, J. R.
Allman, C. F.
Asper, K. O.
Baker, George N.
Bell, R. P.
Berbach, Leo J.
Berger, John S.
Born, J. A.
Bowden, J. M.
Bowen, James T.
Boyden, J. A.
Boyer, S. H.
Bricker, O. F.
Britt, T. E.
Brown, R. J.
Brumbaugh, J. B.
Bryant, Lewis J.
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Caldwell, S. S.
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Campbell, F. A.
Campbell, F. R.
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Chapman, Waldo
Christy, George J.
Cich, George

Cickert, George
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Colclaser, L. A.
Colgan, H. J.
Combs, T. A.
Connell, W. H.
Conway, S. M.
Cope, F. L.
Cordell, G. H.
Corson, C. E.
Cotton, C. S.
Craig, James A.
Cravline, J. H.
Cromwell, Oliver C.
Crum, A. G.
Cubyg, M.
Cunningham, R. H.
Dankmyer, F. C.
Dewhurst, John A.
Dunn, R. G.
Dunsmoor, F. L.
Eichhorn, T. F.
Farrington, Arthur R.
Farrington, Robert J., Jr.
Faust, Clifford A.
Felton, F.
Ferguson, James H., Jr.
Flach, R. A.
Flatley, William J.
Forger, F. G.
Forrester, O. B.
Friend, E. F.
Friend, R. A.
Freuden, Fred
Glaser, G. E.
Goebel, Michael
Gollmer, H. C.
Goodwin, A. E.
Grav, Harold H.
Griffin, T. G.
Grimm, W. R.
Hahn, H. A.
Harding, S. J.
Harper, Kenneth
Hayward, Carlton
Heer, Walter
Herbst, F. A.
Herley, J. E.
Hershey, Charles C.
Hershey, W. G.
Hill, A. H.
Hoffman, C. J.
Hughes, George E.
Hurray, Charles A.
Hykes, William W.
Irwin, Otto Z.
Jablow, Charles
Janis, G. L.
Jenkins, Lenwood
Johnson, A. B.
Jungk, H. G.
Juski, John
Kester, M. B.
Kirschner, H. B.
Kistler, Thomas
Knapp, Ray F.
Knapp, John A.
Kohl, C. G.
Kramer, F. O.
Krolettes, H. J.
Lafgreen, J. L.
Lamborn, J. A.
Lange, Frank R.
Latshaw, T. R.
Laughlin, J.
Leech, George R.
Leerkes, A. R.
Lewis, John J.
Lewis, Ralph S.
Lewis, S. B.
Lewis, Stephen B.
Lipscombe, Mason
Loughridge, H. W.
MacDonald, Donald J.
MacDonald, H. C.
Medcalf, Ross J.
Metzger, C. L.
Meuschke, George
Mikesell, T. R.
Miller, E. B.
Miller, George
Miller, James R.
Miller, R. E.
Miller, Ted
Moles, William G.
Moore, D. M.
Mycoff, George H.
McCormick, E. S.
McCoy, W. J.
McKeever, F. S.
McLean, J. L.
McVicker, J. W.

Neely, Harold
O'Hagan, J. E.
Oldham, R. W.
Oliver, W. E.
O'Neill, F. C.
Pervay, John
Petrie, J. S.
Pollett, R. R.
Porter, R. W.
Rauck, J. F.
Rauschart, R. E.
Reese, George
Reuter, P. P.
Rhinehart, Thomas
Rickenbach, George S.
Riggs, W. F.
Robertson, M. R.
Roddy, C. L.
Ross, B. J.
Roth, Walter A.
Ryan, J. C.
Ryce, Edwin S.
Sable, A. C.
Sable, George T.
Sabol, M. A.
Schadt, A. D.
Schmitt, L. J.
Schott, F. J.
Schrontz, S. B.
Schuch, H. C.
Scofield, W. Y.
Seibert, William C.
Severn, Harry
Shropshire, Paul
Smith, Charles F.
Smith, M. A.
Snyder, H. C.
Spade, Clarence S.
Spratt, Jack
Strehlan, Edward H.
Tepel, J. A.
Terkelsen, B.
Thomas, George P.
Tripp, W. C.
Tripp, W. N.
Trkulja, P. M.
Urtel, E. J.
Vandivort, R. E.
Van Gundy, C. P.
Viess, Samuel
Vogel, E. E.
Wardell, T. J.
Wardrike, N. H.
Warrensford, Fred S.
Wassel, P.
Welter, William P.
West, F.
Wheatley, Albert R.
White, H. A.
White, J. J.
Winkler, Arthur H.
Wolf, Joseph
Woods, G. M.
Wynne, B. E.
Zec, M.

PRESIDENT: We will dispense with the call of the roll as the registration cards afford a full record of attendance.

If there is no objection, we will dispense with the reading of the minutes as the Proceedings have already been published and distributed to the members.

The Secretary will now read the list of proposals for membership.

SECRETARY: We have the following proposals for membership:

Brown, E. L., Assistant Supervisor—Track, Pennsylvania Railroad, 6732 Frankstown Avenue, Pittsburgh, Pa. Recommended by R. H. Flinn.

Carruthers, George R., Draftsman, P. & W. Va. Ry., 5725 Walnut Street, E. E., Pittsburgh, Pa. Recommended by Thomas E. Cannon.

Cunningham, R. H., Salesman, Union Steel Casting Company, Sixty-second and Butler Streets, Pittsburgh, Pa. Recommended by B. F. Mercer.

Dietrick, W. S., Vice-President, Greenville Steel Car Company, Greenville, Pa. Recommended by Samuel Lynn.

Edmiston, R. J., Special Representative, U. S. Granite Company, Fulton Building, Pittsburgh, Pa. Recommended by E. A. Rauschart.

Ferguson, R. G., Electrician, Pennsylvania Railroad, 2446 East Street, N. S., Pittsburgh, Pa. Recommended by F. X. Christy.

Hill, Harold A., Mechanical Engineer, Fort Pitt Malleable Iron Company, 1312 Vine Street, McKees Rocks, Pa. Recommended by E. A. Rauschart.

Huff, A. B., Foreman, Pennsylvania Railroad, 209 Midland Avenue, Carnegie, Pa. Recommended by F. X. Christy.

Klassen, Fred G., Round House Foreman, P. & W. Va. Ry., 27 Oakwood Road, Pittsburgh, (5), Pa. Recommended by Thomas E. Cannon.

Meily, R. P., Trans. Manager, Central District, Westinghouse Electric & Manufacturing Company, Gulf Building, Pittsburgh, Pa. Recommended by G. W. Honsberger.

Orbin, John N., District Manager, Oliver Iron & Steel Corporation, Tenth and Murial Streets, Pittsburgh, Pa. Recommended by Charles F. Spinning.

Rose, A. J., Salesman, Greenville Steel Car Company, Greenville, Pa. Recommended by Samuel Lynn.

Triem, W. R., Superintendent Freight Transportation, Pennsylvania Railroad, 1236 Winterton Street, Pittsburgh, Pa. Recommended by R. H. Flinn.

Weaver, J. E., Car Dispatcher, Gulf Refining Company, Gulf Building, Pittsburgh, Pa. Recommended by G. W. Wildin.

White, Herbert A., Sales Manager, Pittsburgh District, National Bearing Metals Corporation, 928 Shore Avenue, Pittsburgh, Pa. Recommended by E. A. Rauschart.

PRESIDENT: In accordance with our By-laws, these proposals will be referred to the Executive Committee, and upon approval by that Committee the gentlemen will become members without further action of the Club.

SECRETARY: Since our last meeting we have received information of the death of two of our members: A. L. Cromlish, Superintendent, Carnegie Steel Company, Duquesne, Pa., died June 9, 1932, and J. L. Wright, Supervising Agent, Pennsylvania Railroad, Pittsburgh, Pa., died September 27, 1932.

PRESIDENT: An appropriate memorial minute will appear in the next issue of the Proceedings.

The next order of business is the receiving of the Annual Reports. First the Annual Report of the Secretary.

SECRETARY'S REPORT

Pittsburgh, Pa., October 27, 1932.

To the Officers and Members of
The Railway Club of Pittsburgh.

Gentlemen:

The following is a summary of membership and financial statement for the fiscal year ended October 27, 1932:

Membership reported last year	1,054	
Reinstated	7	
Received into membership during year	74	
	——	1,135
Suspended non-payment dues	78	
Resigned	83	
Loss of address	13	
Deaths reported during year	12	
	——	186
Present membership		949

Of the above membership four are honorary. They are: D. C. Buell, D. F. Crawford, Samuel O. Dunn and John A. Penton.

DECEASED MEMBERS

Name	Died
A. L. Cromlish	June 9, 1932
Julian Kennedy	May 28, 1932
Charles R. Long, Jr.	August 12, 1932
W. E. Magill	December 28, 1931

T. J. Martin	July 2, 1932
F. A. Ogden	February 1, 1932
J. E. Patterson	January 30, 1931
H. T. Porter	January 11, 1932
Gilbert E. Ryder	May 17, 1932
A. P. Weston	April 26, 1932
W. J. Wilson	March 8, 1932
J. L. Wright	September 27, 1932

FINANCIAL

Receipts

In hands of Treasurer at close of last year	$7,084.40	
From advertisements	985.11	
From dues	2,235.00	
From sale of Proceedings	19.25	
Smoker Tickets and Dinner, October 22, 1931	354.75	
Miscellaneous sources	3.19	
Interest from U. S. Treasury and Liberty Bonds and bank balance	233.78	
Purchase of three $1,000.00 3⅛% U. S. Treasury Bonds, cost	2,848.18	
		$13,763.66

Disbursements

Printing Proceedings, notices, mailing, etc.	$2,047.00	
Hall, luncheons, cigars, etc.	839.42	
Reporting Proceedings	180.00	
Dinner, entertainment, smoker, etc., October 22, 1931	566.00	
Special entertainment, business meetings	65.00	
Salaries and advertising expenses	1,098.51	
Moving pictures	27.00	
Messenger service, affidavits, etc.	19.00	
Premiums on Bonds—Treasurer and Secretary	16.50	
Purchase of three $1,000.00 U. S. Treasury 3⅛% Bonds, cost	2,848.18	
Federal tax on checks paid	.16	
		$ 7,706.77
Net Balance		$ 6,056.89

Balance is made up of $1,208.71 cash and two U. S. $1,000.00

4¼% Liberty Bonds and three U. S. $1,000.00 3⅛% U. S. Treasury Bonds at cost of $2,848.18.

J. D. CONWAY, Secretary.

APPROVED:

EXECUTIVE COMMITTEE,
FRANK J. LANAHAN, Chairman.

PRESIDENT: This report has been submitted to and approved by the Executive Committee. What is your pleasure?

ON MOTION the report is accepted and referred to the Auditors.

PRESIDENT: We will now have the Annual Report of the Treasurer.

TREASURER: I will ask the Secretary to read the report.

TREASURER'S REPORT

To the Officers and Members of
The Railway Club of Pittsburgh.

Gentlemen:

I herewith submit my report for the year ended October 27, 1932:

ON HAND AND RECEIPTS

Cash on hand, October 22, 1931	$5,084.40	
Moneys received from J. D. Conway, Secretary, from October 22, 1931, to October 27, 1932	3,597.30	
Interest at 4¼% on two $1,000.00 par value Liberty Bonds	85.00	
Interest at 3⅛% on three $1,000.00 par value U. S. Treasury Bonds	93.75	
Interest on bank balance	55.03	
Total Receipts		$8,915.48

DISBURSEMENTS

Paid on Vouchers 743 to 773, inclusive	$7,706.61	
Federal tax on eight checks at 2 cents each	.16	
Total Disbursements		$7,706.77
Balance		$1,208.71

RESOURCES

Two U. S. Liberty Bonds at $1,000.00 each	$2,000.00

Three U. S. Treasury Bonds at purchase price...	2,848.18	
Cash balance	1,208.71	
Total		$6,056.89

We would call your attention to the item of three U. S. Treasury Bonds, bearing interest at 3⅛%, shown in the Resources account. This investment was authorized by the Executive Committee and Finance Committee. The purchase was made in December, 1931, and the investment returns a slightly larger amount of interest than we normally receive on a bank checking account.

E. J. SEARLES, Treasurer.

APPROVED:

EXECUTIVE COMMITTEE,
FRANK J. LANAHAN, Chairman.

PRESIDENT: This report has also been submitted to and approved by the Executive Committee, and, if there is no objection, it will be accepted and referred to the Auditors. Hearing no objection, it is so referred.

We have audited the accounts of the Secretary and Treasurer, and find them correct as reported.

FINANCE COMMITTEE,
LLOYD SUTHERLAND, Chairman.
CHARLES ORCHARD,
J. S. LANAHAN.

PRESIDENT: Next in order is the report of the Tellers of Election.

SECRETARY: The result of the election is as follows: Total number of votes cast 188, and the vote in each case unanimous for the gentlemen named:

PRESIDENT—F. I. Snyder, Vice-President and General Manager, Bessemer & Lake Erie Railroad Company.

FIRST VICE-PRESIDENT—C. O. Dambach, Superintendent, Pittsburgh & West Virginia Railway Company.

SECOND VICE-PRESIDENT—R. H. Flinn, General Superintendent, Pennsylvania Railroad.

TREASURER—E. J. Searles, Manager, Schaefer Equipment Company.

SECRETARY—J. D. Conway.

EXECUTIVE COMMITTEE—Frank J. Lanahan, Chairman; A. Stucki, Samuel Lynn, D. F. Crawford, F. G. Minnick, G. W. Wildin, E. J. Devans, W. S. McAbee, E. W. Smith, Louis E. Endsley, John E. Hughes.

SUBJECT COMMITTEE*—R. P. Forsberg, Chairman; 2 years; H. W. Jones, 1 year; D. W. McGeorge, 3 years.

RECEPTION COMMITTEE*—F. H. Freshwater, Chairman; W. P. Buffington, 1 year; T. F. Sheridan, Harold F. Dunbar, T. E. Cannon, Karl Berg, 2 years; Donald O. Moore, G. M. Sixsmith, 3 years.

ENTERTAINMENT COMMITTEE*—A. B. Severn, Chairman, Joseph H. Kummer, 1 year; J. W. Hoover, 2 years.

FINANCE COMMITTEE*—John B. Wright, Chairman, Charles Orchard, Harry W. Lehr, J. S. Lanahan, 1 year; F. X. Christy, 3 years.

MEMBERSHIP COMMITTEE*—A. F. Coulter, Chairman, F. L. Dobson, J. L. O'Toole, 1 year; T. Fitzgerald, F. J. Nannah, A. M. Frauenheim, H. T. Cromwell, 2 years; E. Emery, E. A. Rauschart, Herbert J. Watt, 3 years.

PRESIDENT: My term of office has reached "the end of a perfect day", but before I call the officers elect to the platform I wish to say that it is with a feeling of regret that I bid official farewell to the members of our Club, who have made possible the experiences of this past year, the greatest of my life.

I also approach the end of my administration with a sense of lack of accomplishment. Further confident am I that out of this period of economic stress, of doubt and of trial, will emerge a finer, stronger and more powerful Club.

I renew my heartfelt thanks and appreciation to you, my fellow members, who have honored me, who have given me matchless experience and recollections, and at the same time I appeal to you that you extend to my successor the same loyal support and co-operation that you have given me. I sincerely thank you.

*In addition to newly elected committee members, the above list also gives names of those previously elected whose terms of office have not yet expired.

It has been customary when you have elected new officers to have them come to the platform and be welcomed. I would like to have the President-elect come forward. I take great pleasure, gentlemen, in presenting to you a man who has been very faithful in his service to this Club, your next President, Mr. F. I. Snyder, Vice-president and General Manager of the Bessemer & Lake Erie Railroad.

MR. F. I. SNYDER: Mr. President and fellow Members: It is not necessary for me to stand here before you and say that it is a compliment to be elected President of this Club. I think you all know it is a compliment. I know it and I treat it as such and I thank you all.

Mr. Hughes, our retiring President, referred a moment ago to a sense of lack of accomplishment. That is unjust to him and it is due to his modesty. He should not have any sense of lack of accomplishment in the past year, because we have completed a wonderful year in the Railway Club. I doubt if there have been any years that have exceeded the past one in interest. We have had a program of wonderful meetings, we have had fine speakers and excellent discussions, and it seems to me that has not been surpassed in any previous season. Any one succeeding to a record of accomplishment like that necessarily will have his hands full.

But there are two things in the Railway Club of Pittsburgh that fortify one in such position. One is that the Club has a great tradition. It is an old Club and it has had for many years a record of constructive work in the discussion of problems of interest to railroad men and those associated with the railroad industry. The second one is a matter that is of inestimable importance, the loyalty of the membership, their support of the meetings and of their officers. With that record of tradition and that condition of loyalty, we will look forward in an effort for as good a season ahead of us as the one just passed under Mr. Hughes, and if we accomplish that we ought to be satisfied, and I know personally I shall be. I thank you.

PRESIDENT: Mr. C. O. Dambach, First Vice-president.

MR. C. O. DAMBACH: Mr. President and fellow Members of the Railway Club of Pittsburgh: I was not aware until I came here tonight that the election to the Vice-presidency carried with it the making of a speech. I appreciate in common with all of you who have been fortunate enough to have seen

the current show hit in New York that "'Tis Not of Me You Sing", however, I wish to say I do appreciate the honor you have conferred upon me and if you will continue to give me your co-operation for the next year and your vote at the expiration of that time, I promise I will have more to say at a later date.

PRESIDENT: Second Vice-president, Mr. R. H. Flinn, General Superintendent, Pennsylvania Railroad.

MR. R. H. FLINN: Mr. President and fellow Members: I haven't anything in particular to say except in appreciation of the honor you have seen fit to bestow upon me. It is an honor. And I can only add that I will continue to give to the Club my support and my interest in the future as I have in the past. I haven't any speech to make, not even an election promise like my friend Dambach.

PRESIDENT: Mr. E. J. Searles, our Treasurer.

MR. E. J. SEARLES: I thank you for the honor of re-election and I will continue to give you my best service in the coming year as I have in the past, but I have no speech to make.

PRESIDENT: We have a long program ahead of us to-night, one that will require your very closest attention. The Entertainment Committee has entrusted the honor of running this entertainment to our good Secretary, and if there is no other business I will turn the meeting over to him. Again I thank you.

SECRETARY: Our President is pretty clever, but if he thinks he can get out of a job like that he is just fooling him-self. I think the Club owes him perhaps a little more than a vote of thanks. And you know we have a gentleman here who is so clever in the use of the English language—you have al-ready guessed who he is—upon whom I will now call to make a few remarks, the gentleman who hails from the "sacred precincts of McKees Rocks" (I hope he will pardon me for stealing that part of his speech), Mr. Frank J. Lanahan.

MR. FRANK J. LANAHAN: It is a pronounced treat to perceive this large audience in their variegated colors of head gear adorning their classic features as they eagerly await the program prepared for their entertainment. It is a splendid turnout, and is indicative of the interest of the members in the

organization. To many of those here tonight it is just another meeting of the Railway Club; to a goodly number, it is recognized as the annual gathering of the membership, but to some of us, it marks a milestone in the history of a most successful institution.

You have heard the virtues of the Railway Club extolled tonight by both the outgoing and the incoming Presidents. Their views were admirably presented. Great credit, according to my measuring stick, should be given to the founders whose foresight, judgment and well conceived plans bore such bounteous fruition. It has succeeded beyond the fondest expectations of those who were its Godparents. In passing, it is appropriate to remark that any organization that has come through this period of unprecedented depression, with results as indicated by the reports tendered tonight, must excite the admiration of similar bodies throughout the country. You just learned that unlike many of us who have invested in "cats and dogs" where the depreciation is 99.9%—the Club is fortunate to have in its treasury, Liberty Bonds that have not been affected, and are the highest grade of investment. It would warm the cockles of the heart of any banker to observe the character of our assets. Now, these things do not just happen; it is no matter of chance, it is the careful attention that has been given to the details of the management of your Club, the careful and watchful policies that we can retrospectively observe as we delve into the history of the organization. The scrupulous care that officials has given during their tenure of office has been most praiseworthy. As we glance back over the yesterdays of the Club's existence and properly appraise the executives from the President who tonight relinquishes his office, on through the successive terms, we cannot help but be filled, with unbound admiration. You may well be proud of those whom you have selected as your leaders. The position that the Club occupies today in its chosen field of activity, is a splendid monument to their revered memory.

In passing out enconiums, there is one important factor of helpfulness that by no means should be overlooked, namely, the Secretary, who continues to function as a directing genius, providing the membership at each meeting with mental stimulants and delicious food, on a basis of $3.00 annual dues. Frequently does he have for our amusement, entertainment of the character as is the attraction this evening. Added to all this is the receipt monthly of the official proceedings by each individual member.

It is just beyond my understanding how Mr. Conway accomplishes all of this.

Again I think you will agree a compliment is due the Subjects Committee, as you heard Mr. Snyder favorably comment on the papers that have been presented in the past twelve months. Truly, they were excellent; they were admirable the year before, and for that matter, the years previous. With this as a basis, it is not much wonder that there is manifested the interest upon the part of the members in their organization.

This meeting signals the changing of executives. Tonight the gavel passes from the old to the new. We bid "Adieu" to our executive of 1932 and accord a "welcome" to the gentleman who will preside over us in 1933. It is the natural order of evolution, and so it is our perogative to extend felicitations to him who relinquishes and accord good wishes to the gentleman who succeeds him. The usual routine has been somewhat departed from tonight by the passing President expressing his feelings of gratitude to the Club as a whole for the co-operation that was manifest during his administration. To others did he give all the credit and assumed but an infinitesimally small part for himself. Ordinarily, I like to agree with people, but truth makes it necessary for me to be entirely at variance with his statement. According to my barometer, John Hughes has been one of the best Presidents the Railway Club has ever had; his interest has been unremitting; he has manifested a spirit of co-operation with others in the organization that is just a little bit higher than we ordinarily expect from chief executives. He has put forth his whole heart into the movement and with zealous care has procured the maximum good out of the possibilities.

It is pleasant for us, John, to realize that you are passing out of the picture. You automatically tonight become a member of the Executive Committee, so we will continue to have your wise counsel and advice, and we rejoice that such is the case. It has been a custom of long standing in the Railway Club of Pittsburgh to tender to its retiring President, some tangible evidence of the appreciation on the part of the entire membership for the services rendered by the gentleman who wielded the gavel during the preceding twelve months. The Committee appointed has made a selection of a token that they sincerely hope will be pleasing to not alone you personally, but your good wife as well.

May I ask you, Mr. Secretary, to pull aside the plush cur-

tain that the members may see how the Committee carried out their mandate to procure a remembrance of them?

(The Secretary then unveiled a magnificent grandfather's clock and a high powered radio. The clock was set going and the radio brought in a powerful musical program with a crash.)

Tonight ends the administration of John Hughes and this assembly wishes to express their gratitude to you as their presiding officer and in their name and on their behalf, I tender to you this Grandfather's Clock and Radio. It is our fond wish as the minutes, the days and the years go by, that as you look at the face of that timepiece or hear it chime, or when tuning in on the radio, that will bring you over the ether, sweet refrains, that your memory will go back to this night of nights in your life and may it engender memories of our joy in having you in our midst, and the triumphs that were yours as the presiding officer in the Railway Club of Pittsburgh during the year 1932.

MR. HUGHES: Mr. Lanahan, officers and members of the Railway Club of Pittsburgh, all my friends, it is hopeless for me to attempt to say anything adequate to you at this time. I thank you, one and all.

A very interesting entertainment program was presented by Maude Ingersoll Productions, as follows:

1—Old Time Hits.

2—Novelty number by Orchestra—"She'll Be Comin' Round the Mountain."

3—Betty and Billy Johnson—"Irish Clog."

4—The Sunshine Triplets—"Jumping Rope Tap Dance."

5—Instrumental solo by Banjoist—"Memories."

6—Song by Ruth Malcolm—"Paradise."

7—The Ingersoll Midgets—"A Flirtation in 1932 Style."

8—Instrumental solo by piano-accordian—"Lazy Day."

9—Eccentric Dance by Betty and Billy Johnson—"Minnie The Moocher."

10—Song by Ruth Malcolm—"Sentimental Gentleman from Georgia."

11—Acrobatic Waltz by Lois Thomas.

12—The Johnson Midgets—"A Flirtation in 1950 Style."

13—Novelty number by Orchestra—"Barnacle Bill The Sailor."

14—The Black and Gold Acrobatic Sextette.

15—Jackie Morrow in Military Tap Dance.

16—Novelty number featuring Helen Thomas, Pianist—"Egyptian Ella."

17—The Johnson Bell Hops.

Following the above entertainment a very sumptuous luncheon was served in the dining room.

J. D. CONWAY, Secretary.

CONSTITUTION

ARTICLE I

The name of this organization shall be "The Railway Club of Pittsburgh."

ARTICLE II

OBJECTS

The objects of this Club shall be mutual intercourse for the acquirement of knowledge, by reports and discussion, for the improvement of railway operation, construction, maintenance and equipment, and to bring into closer relationship men employed in railway work and kindred interests.

ARTICLE III

MEMBERSHIP

Section 1. The membership of this Club shall consist of persons interested in any department of railway service or kindred interests, or persons recommended by the Executive Committee upon the payment of the annual dues for the current year.

Sec. 2. Persons may become honorary members of this Club by a unanimous vote of all members present at any of its regular meetings, and shall be entitled to all the privileges of membership and not be subject to the payment of dues or assessments.

ARTICLE IV

OFFICERS

The officers of this Club shall consist of a President, First Vice President, Second Vice President, Secretary, Treasurer, Finance Committee consisting of five or more members, Membership Committee consisting of seven or more members, Entertainment Committee consisting of three members, Reception Committee consisting of six or more members, Subject Committee consisting of three or more members, and an Elective Executive Committee of three or more members. The officers named shall serve a term of one year from date of their election, with the exception of the Finance, Membership, Entertainment, Reception and Subject Committees; the term of office of these committees shall be specified at the time of the Annual Election, but the term of office of the members of such committees shall not exceed three years.

ARTICLE V

DUTIES OF OFFICERS

SECTION 1. The President shall preside at all regular or special meetings of the Club and perform all duties pertaining to a presiding officer; also serve as a member of the Executive Committee.

SEC. 2. The First Vice President, in the absence of the President, will perform all the duties of that officer; the Second Vice President, in the absence of the President and First Vice President, will perform the duties of the presiding officer. The First and Second Vice President shall also serve as members of the Executive Board.

SEC. 3. The Secretary will attend all meetings of the Club or Executive Committee, keep full minutes of their proceedings, preserve the records and documents of the Club, accept and turn over all moneys received to the Treasurer at least once a month, draw checques for all bills presented when approved by a majority of the Executive Committee present at any meetings of the Club, or Executive Committee meeting. He shall have charge of the publication of the Club Proceedings and perform other routine work pertaining to the business affairs of the Club under the direction of the Executive Committee.

SEC. 4. The Treasurer shall receipt for all moneys received from the Secretary, and deposit the same in the name of the Club within thirty days in a bank approved by the Executive Committee. All disbursements of the funds of the Club shall be by checque signed by the Secretary and Treasurer.

SEC. 5. The Executive Committee will exercise a general supervision over the affairs of the Club and authorize all expenditures of its funds. The elective members of this Committee shall also perform the duties of an auditing committee to audit the accounts of the Club at the close of a term or at any time necessary to do so.

SEC. 6. The Finance Committee will have general supervision over the finances of the Club, and perform such duties as may be assigned them by the President or First and Second Vice Presidents.

SEC. 7. The Membership Committee will perform such duties as may be assigned them by the President or First and Second Vice Presidents and such other duties as may be proper for such a committee.

Sec. 8. The Entertainment Committee will perform such duties as may be assigned them by the President or First and Second Vice Presidents, and such other duties as may be proper for such a committee.

ARTICLE VI

ELECTION OF OFFICERS

Section 1. The officers shall be elected at the regular annual meeting as follows, except as otherwise provided for:

Sec. 2. Printed forms will be mailed to all the members of the Club, not less than twenty days previous to the annual meeting, by the elective members of the Executive Committee. These forms shall provide a method, so that each member may express his choice for the several offices to be filled.

Sec. 3. The elective members of the Executive Committee will present to the President the names of the members receiving the highest number of votes for each office, together with the number of votes received.

Sec. 4. The President will announce the result of the ballot and declare the election.

Sec. 5. Should two or more members receive the same number of votes, it shall be decided by a vote of the members present, by ballot.

ARTICLE VII

AMENDMENTS

Amendments may be made to this Constitution by written request of ten members, presented at a regular meeting and decided by a two-thirds vote of the members present at the next regular meeting.

BY-LAWS

ARTICLE I

MEETINGS

Section 1. The regular meetings of the Club shall be held at Pittsburgh, Pa., on the fourth Thursday of each month, except June, July and August, at 8 o'clock P. M.

Sec. 2. The annual meeting shall be held on the fourth Thursday of October each year.

Sec. 3. The President may, at such times as he deems expedient, or upon request of a quorum, call special meetings.

ARTICLE II

QUORUM

At any regular or special meeting nine members shall constitute a quorum.

ARTICLE III

DUES

Section 1. The annual dues of members shall be Two Dollars, payable in advance on or before the fourth Thursday of September each year.

Sec. 2. The annual subscription to the printed Proceedings of the Club shall be at the published price of One Dollar. Each member of the Club shall pay for both dues and subscription. Dues and subscription paid by members proposed at the meetings in September or October shall be credited for the following fiscal year.

Sec. 3. At the annual meeting members whose dues and subscription are unpaid shall be dropped from the roll after due notice mailed them at least thirty days previous.

Sec. 4. Members suspended for non-payment of dues shall not be reinstated until all arrearages have been paid.

ARTICLE IV

ORDER OF BUSINESS

1—Roll call.
2—Reading of the minutes.
3—Announcements of new members.
4—Reports of Committees.
5—Communications, notices, etc.
6—Unfinished business.
7—New business.
8—Recess.
9—Discussion of subjects presented at previous meeting.
10—Appointment of committees.
11—Election of officers.
12—Announcements.
13—Financial reports or statements.
14—Adjournment.

ARTICLE V

SUBJECTS—PUBLICATIONS

SECTION 1. The Subject Committee will provide the papers or matter for discussion at each regular meeting.

SEC. 2. The Proceedings or such portion as the Executive Committee may approve shall be published (standard size, 6x9 inches) and mailed to the members of the Club or other similar clubs with which exchange is made.

ARTICLE VI

The stenographic report of the meetings will be confined to resolutions, motions and discussions of papers unless otherwise directed by the presiding officer.

ARTICLE VII

AMENDMENTS

These By-Laws may be amended by written request of ten members, presented at a regular meeting, and a two-thirds vote of the members present at the next meeting.

In Memoriam

A. L. CROMLISH

Joined Club April 28, 1932

Died June 9, 1932

J. L. WRIGHT

Joined Club April 23, 1931

Died September 27, 1932

MEMBERS

Aaron, Paul S.,
Fort Pitt Mall. Iron Co.,
304 Grove St.,
McKees Rocks, Pa

Adams, Walter A.,
Clerk,
P. & L. E. R. R.,
230 Ohio Ave.,
Glassport, Pa.

Adler, Abe C.,
Clerk,
Union Railroad Co.,
Linden Ave.,
East Pittsburgh, Pa.

Allan, W. J.,
Treasurer, Commissary Co. of America,
1665 New Haven Ave.,
South Hills Branch,
Pittsburgh, Pa.

Allderdice, Norman,
President & Treasurer,
Arch Machinery Co., Inc.,
1001 Park Bldg.,
Pittsburgh, Pa.

Allen, Harvey,
Mechanical Engineer,
347 Columbia Ave.,
West View,
Pittsburgh, Pa.

Allen, James P.,
1143 Shady Ave.,
Pittsburgh, Pa.

Allinger, Neil J.,
Asst. Supervisor,
Pennsylvania Railroad,
6732 Frankstown Ave.,
Pittsburgh, Pa.

Allison, John,
Sales Engineer,
Pgh. Steel Foundry Corp.,
Glassport, Pa.

Altsman, W. H.,
Mechanical Engineer,
Harmony Railways,
67 Watsonia Blvd.,
N. S., Pittsburgh, Pa.

Ambrose, W. F.,
M. M., Aliquippa & So. R. R.,
1301 Meadow St.,
Aliquippa, Pa.

Ament, Chalmer F.,
Service Inspector,
Pgh. Div., Penna. R. R.,
6932 Standish St.,
Pittsburgh (6) Pa.

Anderson, Burt T.,
Asst. to President,
Union Switch & Signal Co.,
Swissvale, Pa.

Anderson, G. S.,
Foreman,
Penna. System,
Box 19, Penna. Station,
Pittsburgh, Pa.

Anger, C. E.,
Upholsterer Foreman,
P. & L. E. R. R.,
15 Richey Ave.,
N. S., Pittsburgh, Pa.

Anger, John G.,
General Foreman,
P. & L. E. R. R.,
Fifth Ave.,
Coraopolis, Pa.

Anne, George E.,
Representative,
American Brake Shoe & Foundry Co.,
317 Gramacy St.,
Atlantic City, N. J.

Anthony, R. H.,
Freight Claim Agent,
P. & L. E. R. R.,
424 Terminal Bldg.,
Pittsburgh, Pa.

Arensberg, F. L.,
President,
Vesuvius Crucible Co.,
Box 29,
Swissvale, Pa.

Arnold, J. J.,
Sales Dept.,
Pressed Steel Car Co.,
1915 Farmers Bank Bldg.,
Pittsburgh, Pa

Ashley, F. B.,
Vice President,
Pruett Schaffer Chemical Co.,
Tabor St.,
Corliss Station,
Pittsburgh, Pa.

Ashton, Wm. A.,
Die Foreman,
Schoen Works,
Carnegie Steel Co.,
1031 Tyndall St.,
Corliss Station,
Pittsburgh, Pa.

Askin, James A.,
Purchasing Agent,
Fort Pitt Malleable Iron Co.,
438 Russellwood Ave.,
McKees Rocks, Pa.

Atterbury, Gen'l. W. W.,
President, P. R. R. Co.,
1617 Pennsylvania Blvd.,
Philadelphia, Pa.

Aulbach, A. J.,
Yardmaster, P. & L. E. R. R.,
318 Quincy Ave.,
Mt. Oliver Sta.,
Pittsburgh, Pa.

Babcock, F. H.,
Safety Agent,
P. & L. E. R. R.,
221 Magnolia Ave.,
Mt. Lebanon,
Pittsburgh, Pa

Bachner, Martin G.,
P. W. I.—P. & L. E. R. R.,
1109 Church Ave.,
McKees Rocks, Pa.

Baer, Harry L.,
Pres., Water Treatment Co.
of America,
2716 Grant Bldg.,
Pittsburgh, Pa.

Bailey, F. G.,
Mechanical Engineer,
Standard Steel Car Corp.,
P. O. Box 839,
Butler, Pa.

Baily, J. H.,
Vice President,
Edgewater Steel Co.,
P. O. Box 249,
Pittsburgh, Pa.

Bair, J. K.,
Locomotive Engineer,
Union Railroad,
139 Brown Ave.,
Turtle Creek, Pa.

Baird, F. C.,
c/o Duquesne Club,
Pittsburgh, Pa.

Baker, J. B.,
Chief Engr., M. of W.,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Bakewell, Donald C.,
Vice President,
Continental Roll & Steel
Foundry Co.,
2105 Grant Bldg.,
Pittsburgh, Pa.

Balbaugh, John G.,
Sales Engineer,
Pittsburgh Valve Fdy. &
Const. Co.,
26th St. & A. V. Ry.,
Pittsburgh, Pa.

Bald, E. J.,
General Foreman,
Westinghouse E. & M. Co.,
2105 Lloyd Ave.,
Swissvale, Pa.

Ball, Fred M.,
District Manager,
Franklin Ry. Sup. Co., Inc.,
Broad St. Station Bldg.,
Philadelphia, Pa.

Ball, George L.,
Secretary and Treasurer,
Ball Chemical Co.,
230 S. Fairmont Ave.,
Pittsburgh, Pa.

Balzer, C. E.,
Insp'r. of Tests,
P. & L. E. R. R.,
3133 West Carson St.,
Pittsburgh, Pa.

Bandi, John E.,
Bill Clerk, P. C. & Y. R. R.,
1115 Criss St.,
Pittsburgh, Pa.

Barclay, J. R.,
Cost Engineer,
P. & L. E. R. R.,
4 Oakwood Road,
Crafton, Pittsburgh, Pa.

Barnett, Geo.,
Salesman,
W. W. Lawrence Co.,
West Carson St.,
Pittsburgh, Pa.

Barney, Harry,
President-Treasurer,
Barney Machinery Co., Inc.,
2410 Koppers Bldg.,
Pittsburgh, Pa.

Barr, H. C.,
Agent, P. & L. E. R. R.,
3134 West Liberty Ave.,
So. Hills Station,
Pittsburgh, Pa.

Barton, C. B.,
Asst. Gen. Passenger Agent,
Seaboard Air Line Railway,
Union Trust Building,
Pittsburgh, Pa.

Batchelar, E. C.,
Manager, The Motch &
Merryweather Mach'y Co.
1315 Clark Bldg.,
Pittsburgh, Pa.

Beam, E. J.,
Car Builder, Penna. System,
577 Fourth St.,
Pitcairn, Pa.

Beattie, J. A.,
1090 Shady Ave.,
Pittsburgh, Pa.

Beck, John G.,
Representative,
Travelers Insurance Co.,
1649 Shady Ave.,
Pittsburgh, Pa.

Beeson, H. L.,
Engine House Foreman,
Monongahela Ry. Co.,
207 Riverview Terrace,
West Brownsville, Pa.

Bell, D. H.,
Engineer of Car Design,
Pittsburgh Railways Co.,
435 Sixth Ave.,
Pittsburgh, Pa.

Berg, Karl,
Supt. Motive Power,
P. & L. E. R. R.,
6319 Morrowfield Ave.,
Pittsburgh, Pa.

Berghane, A. L.,
Mechanical Expert,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Bernoulli, W. H.,
Pugh Bros.,
211 House Bldg.,
Pittsburgh, Pa.

Best, D. A.,
Chief Test Engineer,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Bihler, L. C.,
Asst. to President,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Binkley, Frank H.,
Yard Foreman,
Union Railroad,
P. O. Box 262,
Unity, Pa.

Bishop, C. L.,
Chief Clerk,
Pittsburgh, Mahoning and
Shenango Valley Freight
Committee,
606 Chamber of
Commerce Bldg.,
Pittsburgh, Pa.

Bittner, George,
Ass't. Engine House Fore.,
Penna. R. R.,
56 Maplewood St.,
Etna, Pa

Blackmore, G. A.,
President & General Mgr.
Union Switch & Signal Co.,
Swissvale, Pa.

Blair, John R.,
Asst. General Mgr. of Sales,
Seamless Tube Div'n.,
Pittsburgh Steel Co.,
Union Trust Bldg.,
Pittsburgh, Pa.

Blest, Minot C.,
Chief Engineer,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Boate, H. S.,
Piece Work Inspector,
P. & L. E. R. R.,
438 Russellwood Ave.,
McKees Rocks, Pa.

Bonhoff, E. L.,
Gen. Fore. Penna. Railroad,
718 Blackburn Road.,
Sewickley, Pa.

Borg, John Edw.,
Chief Draftsman,
Julian Kennedy,
232 Martsolf Ave.,
West View, Pa

Bottomly, E. S.,
Chief Joint Inspector,
P. R. R., B. & O.,
Rdg. and W. M.,
Martinsburg, W. Va.

Bourke, John P.,
Vice President,
Ewald Iron Co.,
501 Fifth Ave.,
New York, N. Y

Bowden, Foster S.,
Asst. Supervisor,
Pennsylvania Railroad,
132 Uhrich St.,
Urichsville, Ohio.

Bowden, T. C.,
Coal Inspector,
B. & L. E. R. R.,
97 S. Mercer St.,
Greenville, Pa

Bowery, Frank J.,
Chief Estimator, F. C. D.,
P. S. C. Co.,
214 Birmingham Ave.,
Avalon, Pa.

Boylan, P. F.,
Expediter,
Pressed Steel Car Co.,
1314 Orchlee St.,
N. S., Pittsburgh, Pa.

Braden, Lou,
3085 Texas Ave.,
Dormont,
Pittsburgh, Pa.

Bradley, W. C.,
C. C. to Gen'l. Supt.,
Union R. R.,
1808 Lafayette St.,
Swissvale, Pa.

Brady, T. Jos.,
President,
T. J. Brady Co.,
303 Kearsage St.,
Mt. Washington Sta.,
Pittsburgh, Pa.

Brant, Wm. J.,
1001 Bessemer Bldg.,
Pittsburgh, Pa.

Braun, Otto F.,
Gen. Mach. Shop Foreman,
P. & L. E. R. R.,
R. D. 1—Herbst Road,
Coraopolis, Pa.

Brendlinger, M. T.,
Gang Foreman,
Penna. R. R. System,
444 Third St.,
Pitcairn, Pa.

Brennan, John T.,
Vice President,
Greenville Steel Car Co.,
Greenville, Pa.

Brennan, T. F.,
Vice President,
B. R. & P. Ry. Co.,
155 Main St., West,
Rochester, N. Y.

Brewer, H. W.,
Supt. of Shops,
B. & O. R. R. Co.,
Du Bois, Pa.

Brown, C. C.,
Rep., Dearborn Chemical Co.,
618 Farmers Bank Bldg.,
Pittsburgh, Pa.

Brown, Charles L.,
Foreman, R. R. Dept.,
Westinghouse Airbrake Co.,
666 Airbrake Ave.,
Wilmerding, Pa.

Brown, E. C.,
Chief Civil Engineer,
Carnegie Steel Co.,
Room 1106,
Carnegie Building,
Pittsburgh, Pa.

Brown, E. L.,
Asst. Supervisor, Track,
Pennsylvania Railroad,
6732 Frankstown Ave.,
Pittsburgh, Pa.

Brown, F. M.,
Supt., P. & L. E. R. R.,
Pittsburgh, Pa.

Brown, J. Alexander,
424 W. 33rd St.,
Eleventh Floor,
New York, N. Y.

Brown, John T., Jr.,
Supt., Federated Metal Corp.,
6667 Woodwell St.,
Pittsburgh, Pa.

Browne, Bard,
Asst. to Vice President,
The Superheater Co.,
60 East 42nd St.,
New York, N. Y.

Bruce, S. S.,
General Traffic Manager,
The Koppers Co.,
Koppers Bldg.,
Pittsburgh, Pa.

Buckbee, W. A.,
The Superheater Co.,
Nyack, N. Y.

Buckwalter, T. V.,
Vice President,
Timken Roller Bearing Co.,
Canton, Ohio.

Buell, D. C.,
Director, The Railway Educational Bureau,
1809 Capitol Ave.,
Omaha, Neb.

Buffington, W. P.,
Traffic Mgr.,
Pittsburgh Coal Co.,
P. O. Box 64,
Pittsburgh, Pa.

Bull, R. S.,
Supt. Power & Inclines,
Pittsburgh Railways Co.,
600 Sandusky St.,
N. S., Pittsburgh, Pa.

Burel, W. C.,
Master Mechanic,
Western Allegheny R. R.,
Kaylor, Pa.

Burgham, Maurice L.,
Sales Department,
Edgewater Steel Co.,
418 Fifth Ave.,
New Kensington, Pa.

Burnette, G. H.,
Asst. Chief Engineer,
P. & L. E. R. R.,
Terminal Building,
Pittsburgh, Pa.

Butler, R. E,
Vice President,
Rust Engineering Co.,
Koppers Bldg.,
Pittsburgh, Pa

Button, D. G.,
Yard Master,
P. & L. E. R. R.,
336 College Ave.,
California, Pa.

Byrne, William L.,
Sales Engineer,
Royal Railway Supply Co.,
House Bldg.,
Pittsburgh, Pa.

Cady, P. C.,
Railway Supplies,
30 Church St., Room 506,
New York City.

Caldwell, C. W.,
Rep., James B. Sipe & Co.,
Chamber of Commerce Bldg.,
Pittsburgh, Pa.

Callahan, F. J.,
Gang Leader,
Montour Railroad,
1109 Chartiers Ave.,
McKees Rocks, Pa.

Callahan, Lawrence H.,
Yardmaster, P. & L. E. R.,
600 Monongahela Ave.,
McKeesport, Pa.

Campbell, Edward D.,
Gen. Freight Agent,
B. & L. E. R. R.,
P. O. Box 456,
Pittsburgh, Pa

Campbell, G. F.,
Division Freight Agent,
P. & L. E. R. R.,
504 Union National Bank Bldg.,
Youngstown, Ohio

Campbell, James E.,
Agent, P. & L. E. R. R.,
512 Twelfth Avenue,
Munhall, Pa.

Campbell, J. T.,
Agent,
B. & O. R. R. Co.,
Thirty-third St.,
Pittsburgh, Pa.

Campbell, W. T.,
Paymaster,
Montour Railroad,
1711 State Ave.,
Coraopolis, Pa

Cannon, J.,
Vice Pres. & Gen. Mgr.,
Missouri Pacific R. R. Co.,
Missouri Pacific Bldg.,
St. Louis, Mo.

Cannon, T. E.,
Gen. Supt., Motive Power & Equipment,
P. & W. Va. Ry.,
Wabash Bldg.,
Pittsburgh, Pa.

Cardwell, J. R.,
President,
Cardwell Westinghouse Co.
332 S. Michigan Ave.,
Chicago, Ill.

Carlson, Frank R.,
Sales Dept., Chicago Rwy.,
Equipment Co.,
1557 Rwy. Exch. Bldg.,
Chicago, Ill.

Carlson, Lawrence E.,
Westinghouse Air Brake Co.,
353 Marguerite Ave.,
Wilmerding, Pa.

Carmack, John L.,
Crane & Shovel Foreman,
Union Railroad,
111 Comrie Ave.,
Braddock, Pa.

Carnahan, W. E.,
Treas., Nat. Casket Co., Inc.,
2216 Oliver Bldg.,
Pittsburgh, Pa.

Carr, T. W.,
Mechanical Engineer,
P. & L. E. R. R.,
400 Island Ave.,
McKees Rocks, Pa.

Carroll, J. H., Jr.,
Freight Traffic Manager,
B. & O. R. R.,
Chicago, Ill.

Carruthers, George R.,
Draftsman,
P. & W. Va. Ry.,
5725 Walnut St.,
E. E., Pittsburgh, Pa.

Carson, John,
Foreman Pattern Shop.,
Ft. Pitt Malleable Iron Co,.
1705 Morningside Ave.,
Pittsburgh, Pa.

Cartwright, Wm. E.,
Pgh. District Mgr.,
National Bearing Metals Corp.,
928 Shore Ave.,
N. S., Pittsburgh, Pa.

Casey, John F.,
Chairman of the Board,
John F. Casey Co.,
P. O. Box 1753,
Pittsburgh, Pa.

Cassidy, David A.,
Gen. Fore., Loco. Dept.,
P. & W. Va. Ry.,
15 W. Main St.,
Carnegie, Pa.

Chaffin, H. B.,
M. M.,
Pennsylvania Railroad,
123 Twelfth St.,
Canton, Ohio

Chalker, A. R.,
Atwood-Bradshaw Corp.,
473 Dawson Ave.,
Bellevue, Pa.

Champion, James H.,
Athletic Director,
Pennsylvania Railroad,
Blawnox, Pa.

Cherry, Jas. T.,
Roadmaster,
P. & W. Va., Ry.,
626 Grandview Ave.,
Carnegie, Pa.

Chilcoat, H. E.,
General Manager of Sales,
Koppel Industrial Car & Equipment Co.,
Koppel, Pa.

Chittenden, A. D.,
Supt. Transportation,
B. & L. E. R. R.,
P. O. Box 456,
Pittsburgh, Pa.

Christfield, J. G.,
Mechanical Engineer,
American Rolling Mill Co.,
Butler, Pa.

Christianson, A.,
Chief Engineer,
Standard Steel Car Co.,
Butler, Pa.

Christy, F. X.,
Inspector,
P. R. R.,
4121 Davison St.,
Arsenal Sta.,
Pittsburgh, Pa.

Church, C. R.,
Retired,
319 Larimer Ave.,
Turtle Creek, Pa.

Cipro, Thomas,
Air Brake Foreman,
Union Railroad Co.,
Box 204,
Unity, Pa.

Clark, C. C.,
Gen. Sales Manager,
Central Dist.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Clark, Chas. H.,
Pres., Clark Car Co.,
R. D. 1,
Library, Pa.

Clement, M. W.,
Vice Pres. Operation,
Penna System,
Broad Street Station,
Philadelphia, Pa.

Clements, B. A.,
President,
American Arch Co., Inc.,
60 E. 42nd Street,
New York City, N. Y.

Clements, Frank C.,
Foreman,
P. & L. E. R. R.,
844 Island Ave.,
McKees Rocks, Pa.

Code, J. G.,
Vice Pres. and Gen. Mgr.,
Jefferson-S'western R. R.Co.,
Mt. Vernon, Ill.

Coffin, C. W. Floyd,
Vice President,
Franklin Railway Supply Co., Inc.,
60 E. 42nd St.,
New York, N. Y.

Coffin, Joel S.,
Chairman, Franklin Ry. Supply Co.,
60 E. 42nd St.,
New York, N. Y.

Colbert, J. T.,
General Superintendent,
Pittsburgh & Shawmut R. R.,
Kittanning, Pa.

Coleman, Jacob C.,
Clerk (Retired),
Union R. R. Co.,
825 Mifflin Ave.,
Wilkinsburg, Pa.

Connely, B. W.
Sawhill Mfg. Co.,
Oliver Building,
Pittsburgh, Pa.

Connors, John M.,
Ass't. Fore. Car Dept.,
Montour Railroad,
208 Sebring St.,
Beechview,
Pittsburgh, Pa.

Conway, J. D.,
Sec'y-Treas., Railway Supply Manufacturers' Association,
1841 Oliver Bldg.,
Pittsburgh, Pa.

Cook, Sidney J.,
Vice-President,
Egan-Webster Co., Inc.,
Grant Bldg.,
Pittsburgh, Pa.

Coombe, A. B.,
Asst. Superintendent,
Pressed Steel Car Co.,
1515 Quail Ave.,
Bellevue, Pa.

Cotter, George L.,
District Engineer,
Westinghouse Air Brake Co.,
103 Biddle St.,
E. E., Pittsburgh, Pa.

Coulter, A. F.,
M. C. B., Union R. R. Co.,
East Pittsburgh, Pa.

Courtney, Harry,
Shop Supt., P. & L. E.,
520 Giffin Ave.,
Mt. Oliver Sta.,
Pittsburgh, Pa.

Covert, G. W., Jr.,
Safety Inspector,
Youngstown & Suburban Ry. Company,
21 East Front St.,
Youngstown, Ohio

Covey, H. S.,
Sec'y, The Cleveland Pneu. Tool Company,
3734 East 78th St.,
Cleveland, Ohio

Cox, Alfred M.,
President,
Pgh. Com'l Heat Treat. Co.,
3710 Liberty Ave.,
Pittsburgh, Pa.

Cox, W. E.,
Asst. Supt.,
Mon. Con. R. R.,
2535 Brownsville Road,
Pittsburgh, Pa.

Craig, W. J.,
Dist. Boiler Inspector,
B. & O. R. R.,
403 Johnston Ave.,
Hazelwood, Pittsburgh, Pa.

Crawford, Alvin B.,
Salesman,
Duquesne Steel Foundry Co.,
1205 Grant Bldg.,
Pittsburgh, Pa.

Crawford, D. F.,
Consulting Engineer,
5243 Ellsworth Ave.,
Pittsburgh, Pa.

Crede, Wm. A.,
Chief Train Clerk,
Office of Supt. Transp'n,
Penna. R. R.,
1605 Clark St.,
Wilkinsburg, Pa.

Crenner, Jos. A.,
Dist. Mgr., Dearborn
Chemical Co.,
618 Farmers Bank Bldg.,
Pittsburgh, Pa.

Croke, Thos. F.,
Foreman,
Ft. Pitt Malleable Iron Co.,
3102 Bergman St.,
Pittsburgh, Pa.

Cromwell, H. T.,
Asst. Supt. Shops,
B. & O. R. R.,
Glenwood Shops,
Pittsburgh, Pa.

Cross, Harry W.,
Arch Machinery Co.,
Park Building,
Pittsburgh, Pa.

Cruikshank, J. C.,
Div. Engr., P. & W. Va. Ry.,
439 Wabash Bldg.,
Pittsburgh, Pa.

Cunningham, J. Donald,
Sales Engineer,
Southern Wheel Co.,
150 Grace Ave.,
Lakewood, Ohio.

Cunningham, J. L.,
Asst. to Gen. Supt. Mo. Power,
Pennsylvania Railroad,
519 Penna. Station,
Pittsburgh, Pa.

Cunningham, R. H.,
Salesman,
Union Steel Casting Co.,
62nd & Butler Sts.,
Pittsburgh, Pa

Cunningham, R. I.,
Mech. Expert, W. A. B. Co.,
606 Hampton Ave.,
Wilkinsburg, Pa.

Cunningham, W. P.,
Supt. Motive Power,
Monongahela Railway Co.,
Box 547,
Brownsville, Pa.

Curley, Walter J.,
President and General Mgr.,
Penna.-Conley Tank Car Co.
Koppers Building,
Pittsburgh, Pa.

Dailey, F. J.,
Lubrication Engineer,
Vacuum Oil Co.,
61 Broadway,
New York, N. Y.

Dalzell, W. E.,
Asst. Planner,
Pressed Steel Car Co.,
1014 Milton St.,
Coraopolis, Pa.

Dambach, C. O.,
Supt. P. & W. Va. Ry.,
Wabash Bldg.,
Pittsburgh, Pa.

Damore, S. A.,
Steam Ditcher Engr.,
P. & L. E. R. R.,
P. O. Box 861,
Monessen, Pa.

Damrau, Edward A.,
Dist. Mgr., The Okonite Co.,
First National Bank Bldg.,
Pittsburgh, Pa.

Danforth, G. H.,
Contracting Engineer,
J. & L. Steel Co.,
3rd Ave. and Ross St.,
Pittsburgh, Pa.

Darr, Elsworth E.,
Yardmaster,
P. & L. E. R. R.,
235 Meridan St.,
Mt. Washington,
Pittsburgh, Pa.

Darrall, William G.,
Engineer Mech.,
Edgewater Steel Co.,
347 James St.,
Springdale, Pa.

Daugherty, W. A.,
Gang Fore., Car Dept.,
Union Railroad,
Box 237,
North Bessemer, Pa.

Davies, Benjamin S.,
General Secretary,
P. & L. E. R. R.—Y. M. C. A.,
Dickerson Run, Pa.

Davies, James,
General Auditor,
Alton & Southern R. R.,
Oliver Building,
Pittsburgh, Pa.

Davin, W. E.,
Roadmaster,
P. & L. E. R. R.,
P. & L. E. Terminal Bldg.,
Pittsburgh, Pa.

Davis, Chas. S.,
Traffic Mgr.,
Standard Tin Plate Co.,
Canonsburg, Pa.

Davis, John W.,
General Manager,
Penn Iron & Steel Co.,
Creighton, Pa.

Day, George W. C.,
Telegraph Censor,
B. & O. R. R.,
718 North Ave.,
Wilkinsburg, Pa.

Deasy, J. F.,
Vice President,
Pennsylvania Railroad,
Pittsburgh, Pa.

Deckman, E. J.,
Pres., E. J. Deckman Co.,
838 Oliver Bldg.,
Pittsburgh, Pa.

Dehne, G. C.,
Asst. to Vice Pres.,
W. A. B. Co.,
Wilmerding, Pa.

DeLaney, Grover C.,
Foreman Construction,
Ally. Co. Road Dept.,
Box 124,
Glassport, Pa.

DeLaney, V. W.,
Superintendent Transp'n,
Youngstown Sheet & Tube Company,
Youngstown, Ohio.

Dellmin, T. D.,
Superintendent,
Lake Erie & East. R. R. Co.,
Struthers, Ohio.

Dempsey, P. W.,
Supt. West. Machine Shop,
Westinghouse Air Brake Co.,
259 N. Dithridge St.,
Pittsburgh, Pa.

Deneke, W. F.,
Terminal Agent,
B. & O. R. R.,
Grant & Water Sts.,
Pittsburgh, Pa.

Dennis, J. G.,
Freight Train Master,
Pennsylvania R. R. System,
324 Pennsylvania Station,
Pittsburgh, Pa.

Derr, A. I.,
Ass't. to President,
P. & W. Va. Ry.,
Wabash Bldg.,
Pittsburgh, Pa.

Devans, E. J.,
Gen. Supt.,
Buffalo-Rochester Dist.,
B. & O. R. R. Co.,
Du Bois, Pa.

Dickinson, F. W.,
M. C. B.,
B. & L. E R. R. Co.,
117 Clinton St.,
Greenville, Pa.

Dickinson, T. R.,
Chief Clerk, Pur. Dept.,
B. & L. E. R. R.,
Union Trust Bldg.,
Pittsburgh, Pa.

Dietrick, W. S.,
Vice-President,
Greenville Steel Car Co.,
Greenville, Pa.

Diller, Clark,
Salesman,
Gustin-Bacon Mfg. Co.,
1021 Filbert St.,
Philadelphia, Pa.

Diven, J. B.,
Supt. Motive Power,
P. R. R. System,
502 Pennsylvania Sta.,
Pittsburgh, Pa.

Dixon, T. L.,
Foreman Mechanical Dept.,
Union Railroad,
140 Greenfield Ave.,
East Pittsburgh, Pa.

Dobson, F. L.,
Superintendent,
Phila. Terminal Division,
Pennsylvania Railroad,
32nd & Powelton Ave.,
West Philadelphia, Pa.

Donovan, J. J.,
Gen. Fore., P. & L. E. R. R.,
426 Jones St.,
Belle Vernon, Pa.

Down, S. G.,
Vice President,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Downes, Daniel F.,
Div. Operator—Pgh. Div.,
Pennsylvania Railroad,
5939 Kirkwood St.,
Pittsburgh, Pa.

Doyle, Timothy E.,
Foreman Painter,
Montour Railroad,
1125 First Ave.,
Coraopolis, Pa.

Draper, Thos.,
President, Draper Mfg. Co.,
Port Huron, Mich.

Dudley, Jesse C.,
Ass't. R. F. of E.,
Penna. R. R.,
603 Hill Ave.,
Wilkinsburg, Pa.

Dunbar, Harold F.,
Sales Rep., McConway & Torley Corp'n.,
48th St. & A. V. R. R.,
Pittsburgh, Pa.

Dunlap, Robert J., Jr.,
Terminal Foreman,
Montour Railroad Co.,
Willock, Pa.

Dunn, Samuel O.,
Editor, Railway Age Gazette,
105 W. Adams St.,
Chicago, Ill.

Durkin, Jas. E.,
Asst. Superintendent,
Ft. Pitt Mall. Iron Co.,
905 Second St.,
McKees Rocks, Pa.

Duryea, O. C.,
President,
O. C. Duryea Corp'n,
Nixon Hotel,
Butler, Pa.

Eagan, D. F.,
Asst. T. M. & Div. Opr.,
Penna. System,
39 Mt. Oliver St.,
Pittsburgh, Pa.

Earley, J. T.,
Ind. Sales Rep.,
Indianapolis Varnish Co.,
Box 114,
Saxonburg, Pa.

Eckes, Joseph M.,
Salesman,
Railway Products Co.,
Grant Bldg.,
Pittsburgh, Pa.

Edgett, Joseph W.,
Sales Engineer,
Walworth Co.,
604 Chamber of Commerce Bldg.,
Pittsburgh, Pa.

Edgin, Geo. A.,
Asst. Sales Manager,
The Duff-Norton Mfg. Co.,
2709 Preble Ave.,
N. S., Pittsburgh, Pa.

Edmiston, R. J.,
Special Representative,
U. S. Graphite Co.,
Fulton Bldg.,
Pittsburgh, Pa

Edwards, Clifton H.,
Storekeeper, Ft. Pitt
Malleable Iron Co.,
1406 Chartiers Ave.,
McKees Rocks, Pa.

Eichenlaub, W. C.,
Sales Manager,
Pittsburgh Steel Foundry
Corp.,
Glassport, Pa.

Ellis, C. B.,
Gen. Traffic Manager,
Gulf Refining Co.,
P. O. Box 1214,
Pittsburgh, Pa.

Emery, E.,
Railway Supplies,
6511 Darlington Road,
Pittsburgh, Pa.

Emsheimer, Louis,
Machinist,
Pennsylvania Railroad,
1439½ Elm St.,
Wilkinsburg, Pa.

En Dean, J. F.,
Inspecting Engineer,
P. & L. E. R. R.,
436 Edgemont St.,
Knoxville,
Pittsburgh, Pa.

Endsley, Louis E., Prof.,
Consulting Engr.,
516 East End Ave.,
Pittsburgh, Pa.

England, Alexander,
Chief Engineer,
W. A. B. Co.,
428 Biddle Ave.,
Wilkinsburg, Pa.

Erickson, L. S.,
Traveling R. R. Sec'y.,
Y. M. C. A.,
407 Calder Bldg.,
Harrisburg, Pa.

Ernest, E. E.,
Supt. Passenger Transp'n.,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Evans, David F.,
Dist. Manager,
The Duff-Norton Mfg. Co.,
N. S., Pittsburgh, Pa.

Evans, Robert E.,
General Yardmaster,
Pennsylvania Railroad,
814 Norwich St.,
Pittsburgh, Pa

Faix, Joseph,
P. W. I. F., P. & L. E. R. R.,
639 Michigan Ave.,
Glassport, Pa.

Falkner, Andrew J.,
Clerk,
B. & O. R. R.,
4014 Coleman St.,
Pittsburgh, Pa.

Farmer, C. C.,
Director of Engineering,
W. A. B. Co.,
Wilmerding, Pa.

Farrell, G. R.,
Sales Agent,
Nat'l Mall. & Steel Cstgs. Co.,
10600 Quincey Ave.,
Cleveland, Ohio

Farrington, Robert J.,
General Foreman,
P. & L. E. R. R.,
1318 Vine St.,
McKees Rocks, Pa.

Fay, Frank L., Hon.,
Chairman of the Board,
Greenville Steel Car Co.,
Greenville, Pa.

Fendner, W. J.,
Mechanical Engineer,
Schaefer Equipment Co.,
Koppers Bldg.,
Pittsburgh, Pa.

Fenton, H. H.,
District Supt.,
Pittsburgh Railways,
435 Sixth Ave.,
Pittsburgh, Pa.

Ferguson, R. G.,
Electrician,
Pennsylvania Railroad,
2446 East St.,
N. S., Pittsburgh, Pa.

Ferrick, John T.,
Freight Cashier,
P. & L. E. R. R.,
Terminal Annex,
Pittsburgh, Pa.

Fettinger, H. O.,
Rep., Ashton Valve Co.,
21 Albany St.,
New York, N. Y.

Fields, S. H.
Vice-President,
Koppers Products Co.,
Koppers Bldg.,
Pittsburgh, Pa.

Fieldson, P. H.,
Asst. Master Car Builder,
P. & L. E. R. R.,
1303 Broadway,
McKees Rocks, Pa.

Filson, Harry T.,
Engine Dispatcher,
Montour Railroad,
George St.,
Coraopolis, Pa.

Finegan, Leo,
Superintendent,
Flannery Bolt Co.,
Keystone Athletic Club,
Pittsburgh, Pa.

Fink, Peter J.,
General Car Foreman,
P. & L. E. R. R.,
328 Amabell St.,
19th Ward,
Pittsburgh, Pa.

Fischer, G. E.,
Clerk, Union Railroad,
2202 Hampton St.,
Swissvale, Pa.

Fisher, E. M.,
Asst. R. F. of E.,
Penna. Railroad System,
909 E. Washington St.,
New Castle, Pa.

Fisher, G. Malcolm,
Blacksmith Foreman,
Union R. R.,
R. F. D. 1—Box 466,
Wilkinsburg, Pa.

Fisher, Harry G.,
Clerk, B. R. & P. Ry.,
2455 Wenzel Ave.,
Pittsburgh, Pa.

Fisher, John J.,
Trav. Car Inspector,
7234 McClure Ave.,
Swissvale, Pa.

Fitzgerald, T.,
Vice President,
Pittsburgh Railways Co.,
435 Sixth Ave.,
Pittsburgh, Pa.

Fitzsimmons, E. S.,
Mgr. Sales,
Flannery Bolt Co.,
Flannery Bldg.,
Pittsburgh, Pa.

Flaherty, P. J.,
Pres. and General Mgr.,
Johnson Bronze Co.,
So. Mill Street,
New Castle, Pa.

Flannery, J. Rogers,
President,
Flannery Bolt Co.,
Flannery Bldg.,
Pittsburgh, Pa.

Fleck, John S.,
Chief Transp'n Clerk,
Passenger
Penna. R. R.,
625 Kirtland St.,
Pittsburgh, Pa.

Fleckenstein, August,
P. W. Insp'r., P. & L. E. R. R.,
1108 Crucible St., 20th Wd.,
Pittsburgh, Pa.

Flinn, R. H.,
General Superintendent,
Penna. Railroad,
Penn. Station,
Pittsburgh, Pa.

Follett, W. F.,
Asst. Supt.,
Aliquippa & Southern R. R.,
106 King St.,
Aliquippa, Pa.

Foote, Frederick D.,
President,
Greenville Steel Car Co.,
1920 Grant Bldg.,
Pittsburgh, Pa.

Forney, H. L.,
"Retired" Master Carpenter,
B. & O. R. R.,
582 South Aiken Ave.,
Pittsburgh, Pa.

Forsberg, R. P.,
Chief Engineer,
P. & L. E. R. R.,
P. & L. E. Terminal Bldg.,
Pittsburgh, Pa.

Foster, F. L.,
Supt. Frt. Transportation,
P. & L. E. R. R.,
Pittsburgh, Pa.

Fowler, W. E.,
Vice-Pres. & Gen. Mgr.,
Pgh., Lisbon & Western
R. R.,
21 East Front St.,
Youngstown, Ohio

Fox, George W.,
Secretary,
Davis Brake Beam Co.,
146 Second Avenue,
Westmont,
Johnstown, Pa.

Frauenheim, A. M.,
Vice President,
Standard Auto-Tite Joints Co.
7501 Thomas Blvd.,
Pittsburgh, Pa.

Frauenheim, Pierce H.,
Standard Auto-Tite Joints Co.,
7501 Thomas Blvd.,
Pittsburgh, Pa.

Freshwater, F. H.,
Sales Agent,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Fretz, R. I.,
District Sales Representative,
Reading Iron Co.,
First National Bank Bldg.,
Pittsburgh, Pa.

Fritz, A. A.,
Clerk, Mon. Conn. R. R.,
133 Stewart Ave.,
Mt. Oliver Station,
Pittsburgh, Pa.

Fry, Lawford H.,
Railway Engineer,
Edgewater Steel Co.,
P. O. Box 249,
Pittsburgh, Pa.

Fults, John H.,
Clerk,
Union National Bank,
Wood Street,
Pittsburgh, Pa.

Funfer, James,
Gang Fore., Car Dept.,
Union Railroad Co.,
R. F. D. No. 1,
Turtle Creek, Pa.

Furch, George J.,
Gang Fore., Penna. System,
705 High St.,
Freeport, Pa.

Gaffney, Thomas H.,
Roadmaster,
Montour Railroad,
1364 Fourth Ave.,
Coraopolis, Pa.

Gallinger, Geo. A.,
Gen. Manager, Pneumatic
Sales, Ingersoll-Rand Co.,
11 Broadway,
New York, N. Y.

Gallowich, Louis J.,
Car Inspector,
Pennsylvania Railroad,
3 Matson St.,
N. S. Pittsburgh, Pa.

Gammiere, E. J.,
Fore., Core Dept.,
Ft. Pitt Malleable Iron Co.,
107 Jane St.,
McKees Rocks, Pa.

Gardner, George R.,
Chief Clerk—Traffic Dept.,
Pittsburgh Coal Co.,
1024 Oliver Bldg.,
Pittsburgh, Pa.

Gardner, Jas. E.,
Spl. Rep. Schaffer Equipt. Co.
Koppers Bldg.,
Pittsburgh, Pa.

Garland, W. L.,
V. P., Safety Car Htg. & Ltg. Co.,
1160 Broad St. Station Bldg.,
Philadelphia, Pa.

Garlow, Andrew,
Airbrake Inspector,
Union Railroad,
North Bessemer, Pa.

Gates, C. F.,
Asst. Chief Clerk,
P. & L. E. R. R.,
Pittsburgh, Pa.

Gatfield, Philip I.,
Mechanic,
Keystone Sand & Supply Co.,
219 Zara St.,
Knoxville,
Pittsburgh, Pa.

Geddes, James R.,
V. P. and Gen. Supt.,
Mon. Con. R. R. Co.,
3540 Second Ave.
Pittsburgh, Pa.

Geisler, Jos. J.,
Mech. Engineer,
Ft. Pitt Mall. Iron Co.,
1023 Chartiers Ave.,
McKees Rocks, Pa.

Gellatly, Wm. R.,
President,
Superior Railway Products Corp.,
Thomas Boulevard,
Pittsburgh, Pa.

George, R. H.,
Assistant Engineer,
P. & L. E. R. R.,
Terminal Building,
Pittsburgh, Pa.

Gerber, Harry L.,
Template Checker,
Pressed Steel Car Co.,
2739 Merwyn Ave.,
Corliss Station,
Pittsburgh, Pa.

Germak, George A.,
Car Inspector,
P. & L. E. R. R.,
529 Indiana Ave.,
Glassport, Pa.

Gilg, Henry F.,
Railway Supplies,
1424 Orchlee St.,
N. S., Pittsburgh, Pa.

Gill, C. A.,
S. M. P. & Rolling Equip't.,
Reading Co.,
Reading, Pa.

Gillespie, J. Porter,
Ass't. Gen'l. Supt.,
Lockhart Iron & Steel Co.,
P. O. Box 1243,
Pittsburgh, Pa.

Gillespie, John M.,
Vice President,
Lockhart Iron & Steel Co.,
P. O. Box 1243,
Pittsburgh, Pa.

Glaser, J. P.,
Auditor Disbursements,
P. & L. E. R. R.,
909 Bellaire Ave.,
Pittsburgh, Pa.

Glenn, J. H.,
R. F. of E. P. & W. Va. Ry.,
20 Obey St.,
Pittsburgh, Pa.

Glessner, Geo. P.,
Wrecker Engineer,
Union Railroad,
R. D. No. 2,
Turtle Creek, Pa.

Goda, P. H.,
Foreman, P. R. R.,
602 Whitney Ave.,
Wilkinsburg, Pa.

Goff, J. P.,
Asst. T. M., P. & L. E. R. R.,
615 Montour St.,
Coraopolis, Pa.

Goodman, O. F.,
Sales Engineer,
Worthington Pump &
Machinery Corp.,
Koppers Bldg.,
Pittsburgh, Pa

Gorby, Frank E.,
Supt., Union R. R.,
East Pittsburgh, Pa.

Gorman, Charles,
District Manager,
The Garland Co.,
302 McCance Bldg.,
Pittsburgh, Pa.

Goron, F. W.,
Asst. Gen. Foreman,
P. & L. E. R. R.,
874 Railroad St.,
McKees Rocks, Pa.

Graham, A. C.,
Traffic Manager,
Youngstown Sheet and
Tube Company,
Stambaugh Bldg.,
Youngstown, Ohio.

Graham, Chas. J.,
President,
Bolt, Nut and Rivet Mfrs.
Association,
3001 Grant Bldg.,
Pittsburgh, Pa.

Graham, H. E.,
Asst. to Pres. & Gen. Traf
Mgr.,
Jones & Laughlin Steel
Corp.,
3rd Ave. & Ross St.,
Pittsburgh, Pa.

Graham, Harry C.,
Pittsburgh Screw and Bolt
Corporation,
P. O. Box 72,
Pittsburgh, Pa

Graham, James,
Inspector, P. R. R. System,
806 Southern Ave.,
Mt. Washington Sta.,
Pittsburgh, Pa

Gray, Guy M.,
S. M. P.,
B. & L. E. R. R. Co.,
Greenville, Pa.

Grieve, Robert E.,
Passenger Train Master,
P. R. R.,
740 East End Ave.,
Pittsburgh, Pa.

Grimshaw, F. G.,
Works Mgr., P. R. R. Sys.,
Altoona, Pa.

Grove, C. G.,
Division Engineer,
Pennsylvania Railroad,
9 Dinsmore Ave.,
Crafton, Pa.

Guinnip, M. S.,
Sales Engineer,
Ingersoll-Rand Co.,
706 Chamber of Commerce Bldg.,
Pittsburgh, Pa.

Gunnison, Walter L.,
Representative,
Enterprise Railway
Equipment Co.,
Buckingham Building,
Chicago, Ill.

Guy, W. S.,
Traffic Manager,
Carnegie Steel Co.,
812 Carnegie Bldg.,
Pittsburgh, Pa.

Gwaltney, R. H.,
Vice President,
The Symington Co.,
230 Park Ave.,
New York, N. Y.

Hackett, C. M.,
Boiler Maker Fore.,
Penna. R. R.,
618 Pennsylvania Ave.,
Oakmont, Pa.

Hale, Chas. E.,
Baldwin Loco. Works,
Paschall Station,
Philadelphia, Pa.

Hall, Charles B.,
Supt. Coal Docks,
Union Railroad Co.,
1600 Vermont Ave.,
McKeesport, Pa.

Hall, Chester C.,
Truck Driver,
J. T. & A. Hamilton Co.,
26th & Smallman Sts.,
Pittsburgh, Pa.

Haller, C. T.,
President,
Colonial Supply Co.,
217 Water St.,
Pittsburgh, Pa.

Haller, Nelson M.,
Sup'r. Scrap & Reclamation,
P. & L. E. E. R. R.,
5853 Aylesboro Ave.,
Pittsburgh, Pa.

Hamilton, Hugh M.,
General Foreman, Pass. Cars,
Pressed Steel Car Co.,
3026 Merwyn Ave.,
Corliss Station,
Pittsburgh, Pa.

Hamilton, W. H.,
Supt. Roadway & Structures,
Montour Railroad,
Coraopolis, Pa.

Hammond, H. S.,
Sales Agent,
Pressed Steel Car Co.,
80 Broad St.,
New York, N. Y.

Hancock, Milton L.,
Office Engineer,
Westinghouse Air Brake Co.,
557 Broadway Extension,
East McKeesport, Pa.

Hankins, F. W.,
Chief of Motive Power,
Pennsylvania Railroad,
1617 Pennsylvania Blvd.,
Philadelphia, Pa.

Hanna, R. B.,
Chief Clerk to Supt.,
P. & L. E. R. R.,
Pittsburgh, Pa.

Hannan, Frank A.,
Real Estate & Insurance,
1008 Benedum-Trees Bldg.,
Pittsburgh, Pa.

Hansen, Wm. C.,
Sales Engr., A. Stucki Co.,
419 Oliver Bldg.,
Pittsburgh, Pa.

Harbaugh, Chas. P.,
Wreck Master,
Union Railroad,
East Pittsburgh, Pa.

Hare, J. K. B.,
Central Transp'n Manager,
Westinghouse Elec. &
Mfg. Co.,
Grant Bldg.,
Pittsburgh, Pa.

Harger, E. S.,
General Foreman,
P. & L. E. R. R.,
1455 Myrtle Ave.,
New Brighton, Pa.

Harper, A. M.,
Mgr. of Sales,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Harper, G. C.,
General Supt.,
Montour Railroad,
1711 State Ave.,
Coraopolis, Pa.

Harper, J. T.,
Asst. To Mech. Supt.,
Montour Railroad,
R. F. D. No. 1,
McKees Rocks, Pa.

Harper, James W.,
Medical Examiner,
Penna. R. R.,
5121 Bayard St.,
Pittsburgh, Pa.

Harter, Arnold,
Ass't Fore., W. A. B. Co.,
353 Marguerite Ave.,
Wilmerding, Pa.

Hastings, Walter S.,
R. F. of E.,
Aliquippa & Southern R. R.,
Aliquippa, Pa.

Hays, Harry E.,
R. F. of E.,
Pennsylvania Railroad,
16 West Leasure Ave.,
New Castle, Pa.

Hayward, Carlton,
C. C. to Gen. Supt. Motive Power,
Pennsylvania R. R.,
6349 Walnut St.,
Pittsburgh, Pa.

Heckman, C. J.,
Draftsman,
Spang, Chalfant Co.,
129 Sixth St.,
Aspinwall, Pa.

Heffelfinger, A. E.,
Sales Manager,
The Symington Co.,
230 Park Ave.,
New York City.

Hektner, Joel,
Asst. Engr., Ry. Division,
Timken Roller Bearing Co.,
Canton, Ohio.

Henderson, Geo. L.,
Engr., P. & L. E. R. R.,
228 Sheridan Ave.,
New Castle, Pa.

Henry, C. L.,
Asst. M. M., Penna. R. R.,
Mingo Junction, Ohio.

Henry, Frank P.,
General Foreman,
Carnegie Steel Co.,
36 Danvers Ave.,
Ingram, Pa.

Hepburn, P. W.,
Lubricating Engineer,
Gulf Refining Co.,
6963 Frankstown Ave.,
Pittsburgh, Pa.

Herald, M. A.,
President, United Car &
Equipment Company,
Westinghouse Bldg.,
Pittsburgh, Pa.

Herbert, T. C.,
Superintendent,
Pennsylvania Railroad,
1013 Penn Ave.,
Pittsburgh, Pa.

Herlehy, David T.,
P. W. I. F., P. & L. E. R. R.,
Ohio Ave.,
Glassport, Pa.

Herrold, A. E.,
M. M. & M. C. B.,
Mon. Conn. R. R.,
3915 Winterburn Ave.,
Pittsburgh, Pa.

Hershey, Quincy W.,
Supervisor of Maintenance
Sales, Westinghouse
E. & M. Co.,
7527 Rosemary Road,
Pittsburgh, Pa.

Hervey, R. S.,
Auditor Freight Accounts,
P. & L. E. R. R.,
722 Main St.,
Coraopolis, Pa.

Hettler, R. C.,
Foreman, Car Dept.,
Penna. Railroad,
3809 Brighton Road,
N. S., Pittsburgh, Pa.

Hiester, E. G.,
Ass't Dining Car Agent,
Penna. R. R.,
3125 Perrysville Ave.,
Pittsburgh, Pa.

Hill, Harold A.,
Mechanical Engineer,
Fort Pitt Malleable
Iron Co.,
1312 Vine St.,
McKees Rocks, Pa.

Hill, W. D.,
Auditor,
Monongahela Rwy. Co.,
Century Bldg.,
Pittsburgh, Pa.

Hilstrom, Anton V.,
Machinery Inspector,
P. & L. E. R. R.,
P. O. Box 192,
Glenfield, Pa.

Hodge, Edwin, Jr.,
President,
Pittsburgh Forgings Co.,
Grant Bldg.,
Pittsburgh, Pa.

Hoffstot, H. P.,
Vice President,
Pressed Steel Car Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Hogg, Francis,
Designer,
General Electric Co.,
2326 Station Road,
Wesleyville, Pa.

Holiday, Harry,
Manager of Works,
The American Rolling
Mill Company,
Butler, Pa.

Holmes, E. H.,
Sales Department,
Ft. Pitt Malleable Iron Co.,
3662 Middletown Road,
Corliss Station,
Pittsburgh, Pa.

Holohan, S. V.,
Passenger Conductor,
B. & O. R. R.,
364 Norwood Ave.,
Buffalo, N. Y.

Honsberger, G. W.,
Salesman,
Westinghouse E. & M. Co.,
Gulf Bldg.,
Pittsburgh, Pa.

Hood, J. M.,
Chemist, Ft. Pitt Malleable
Iron Co.,
419 Russellwood Ave.,
McKees Rocks, Pa.

Hoover, Jacob W.,
Chief Traffic Dispatcher,
Carnegie Steel Co.,
816 Carnegie Bldg.,
Pittsburgh, Pa.

Horner, William,
General Yardmaster,
Mon. Con. R. R. Co.,
3526 Beechwood Blvd.,
Pittsburgh, Pa.

Hosford, Charles C.,
General Scale Inspector,
Pennsylvania Railroad,
6625 Ohio River Blvd.,
Ben Avon, Pa.

Howard, L. F.,
Chief Engineer,
Union Switch & Signal Co.,
Swissvale, Pa.

Howe, Harry,
Eng'r. of Ry. Equip't.,
Manganese Steel Forge Co.,
Richmond & Castor Ave.,
Philadelphia, Pa.

Hubacher, O. H.,
Locomotive Engineer,
P. & L. E. R. R.,
914 Broadway,
McKees Rocks, Pa.

Huber, H. G.,
Master Mechanic, P. R. R.,
206 Pennsylvania Station,
Pittsburgh, Pa.

Huff, A. B.,
Foreman,
Pennsylvania Railroad,
209 Midland Ave.,
Carnegie, Pa.

Hughes, I. Lamont,
President,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Hughes, J. E.,
General Agent,
P. & L. E. R. R.,
504 Union Bank Bldg.,
Youngstown, Ohio.

Humphrey, A. L.,
Executive Director,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Hunt, Lawrence,
Gen. Fore., Tank Car Dept.,
Pressed Steel Car Co.,
272 Balph Ave.,
Bellevue, Pa.

Hursh, P. S.,
Supervisor Boilers,
B. & O. R. R.,
17 Linden Ave.,
DuBois, Pa.

Huston, Frederick T.,
Master Mechanic,
Pennsylvania Railroad,
611 Pennsylvania Station,
Pittsburgh, Pa.

Hykes, W. H.,
Assistant Trainmaster,
Penna. R. R. Co.,
526 Sixth St.,
Oakmont, Pa.

Hyndman, F. T.,
3115 Lincoln Blvd.,
Cleveland, Ohio

Inks, S. W.,
General Foreman,
P. & L. E. R. R.,
Box 253,
Dawson, Pa.

Irwin, Robert D.,
Foreman,
Westinghouse Air Brake Co.,
521 Holmes St.,
Wilkinsburg, Pa.

Jack, Arthur C.,
Engineer, Track Appliances,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Jackson, W. M.,
Asst. R. F. of E.,
Pennsylvania Railroad,
48 Paul Place,
Buffalo, N. Y.

Jenkner, Oscar,
G. Y. M., Union R. R.,
503 Hunter St.,
Turtle Creek, Pa.

Jenneas, D. H.,
R. F. of E., Penna. R. R.,
801 Heberton Ave.,
Pittsburgh, Pa.

Johnson, E. A.,
15 N. Euclid Ave.,
Bellevue, Pittsburgh, Pa.

Johnson, George T.,
Vice President, The
Buckeye Steel Castings Co.,
South Parsons Ave.,
Columbus, Ohio

Johnson, I. S.,
Resident Material Inspector,
The Pennsylvania Railroad,
Room 402, 1013 Penn Ave.,
Pittsburgh, Pa.

Johnson, J. W.,
City Mgr., Amer.
Rwy. Express Co.,
926 Penn Ave.,
Pittsburgh, Pa.

Johnson, Wm. M.,
Gen. Superintendent,
B. & L. E. R. R.,
Greenville, Pa.

Johnston, C. DeLos,
Chief Clerk to Asst. Supt.,
P. & L. E. R. R.,
370 Dravo Ave.,
Beaver, Pa.

Johnston, Geo. E.,
Clerk, Union Railroad,
Box 92,
Lincoln Place, Pa.

Johnston, Harvey F.,
Rate Clerk,
P. & L. E. R. R.,
McKees Rocks, Pa.

Johnston, J. C.,
Yard Master,
Union R. R. Co.,
North Bessemer, Pa.

Johnston, W. A.,
Gang Foreman,
Penna. R. R.,
R. D. 2,
Pitcairn, Pa.

Jones, H. W.,
Gen. Supt., Motive Power,
Pennsylvania Railroad,
905 Maryland Ave.,
Pittsburgh, Pa.

Jones, L. E.,
Asst. To Chief Civil Engineer,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Jones, Louis E.,
Department Manager,
American Steel Foundries,
North Wrigley Bldg.,
Chicago, Ill.

Jones, William M.,
Clerk, Union Railroad,
5020 Glenwood Ave.,
Hazelwood Sta.,
Pittsburgh, Pa.

Joyce, P. H.,
President,
Standard Steel Car Corp.,
79 East Adams St.,
Chicago, Ill.

Karnes, W. T.,
General Foreman,
P. & L. E. R. R.,
330 Ohio Ave.,
Glassport, Pa.

Kaup, Harry E.,
Gen. Supt.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Kavanagh, D.,
Storekeeper,
Union Railroad,
East Pittsburgh, Pa.

Kearney, J. W.,
President The R. & M. E. Co.,
909 Midland Bank Bldg.,
Cleveland, Ohio

Keefe, Edward A.,
Coal Billing Agent,
B. & O. R. R.,
112 Grandview Ave.,
Mt. Washington,
Pittsburgh, Pa.

Keenoy, R. P.,
V. P. & G. S., D. S. R. R.,
902 Jancey St.,
E. E., Pittsburgh, Pa.

Kelin, H. S.,
Draftsman, Union R. R. Co.,
R. F. D. 4, Box 208-L,
Millvale,
Pittsburgh, Pa.

Kellenberger, K. E.,
Advertising Manager,
Union Switch & Signal Co.,
P. O. Box 127,
Wilkinsburg, Pa.

Keller, R. B.,
Supervisor,
Air Reduction Sales Co.,
1116 Ridge Ave.,
N. S., Pittsburgh, Pa.

Keller, R. E.,
Lead Car Inspector,
P. & L. E. R. R.,
560 Stokes Ave.,
Braddock, Pa.

Kelly, H. B.,
Gen. R. F. of E.,
P. & L. E. R. R.,
3019 Bergman, St.,
Corliss Station,
Pittsburgh, Pa.

Kelly, J. P.,
Asst. Superintendent,
P. & L. E. R. R.,
922 School St.,
Coraopolis, Pa.

Kelly, J. W.,
Boiler Tube Expert,
National Tube Co.,
515 N. Grove Ave.,
Oak Park, Ill.

Kelly, Leo F.,
Sales Representative,
Pgh. Screw & Bolt Corp.,
3913 California Ave.,
N. S., Pittsburgh, Pa.

Kelly, Leo J.,
Superintendent,
Ft. Pitt Mall. Iron Co.,
3036 Bergman St.,
Pittsburgh, Pa.

Kempton, J. W.,
Gen. Sec'y, Y. M. C. A.,
P. & L. E. R. R.,
Newell, Pa.

Kennedy, A. R.,
Traffic Manager,
Pittsburgh Steel Co.,
Union Trust Building,
Pittsburgh, Pa.

Kennedy, F. D.,
Supt. Railway Dept.,
Westinghouse Elec. &
Mfg. Co.,
220 Bevington Road,
Wilkinsburg, Pa.

Kennedy, F. J.,
Auditor Pass. Accounts,
P. & L. E. R. R.,
Box 206,
New Brighton, Pa.

Kerby, Frederick,
Asst. to Chief of Motive
Power and Equipment,
B. & O. R. R.,
218 Pennsylvania Ave.,
Cumberland, Md.

Kern, Roy S.,
Chairman,
Coal, Coke & Iron Ore
Com.,
Wabash Bldg.,
Pittsburgh, Pa.

Kernan, John L.,
340 Russellwood Ave.,
McKees Rocks, Pa.

Kerr, Clark R.,
Asst. Car Foreman,
Union Railroad Co.,
East Pittsburgh, Pa.

Ketchpel, Paul A.,
Development Engineer,
Standard Stoker Co.,
350 Madison Ave.,
New York, N. Y.

Keys, Arthur H.,
General Car Foreman,
B. & O. R. R.,
2938 Glenmore Ave.,
Dormont, Pittsburgh, Pa.

Kight, R.,
Asst. Gen. Yard Master,
Western Maryland Ry. Co.,
Thomas, W. Va

Kimling, Karl,
Asst. Mgr., Central Whse.,
P. & L. E. R. R.,
85 Harwood Street,
Pittsburgh, Pa.

King, C. F., Jr.,
General Engineer,
Westinghouse Elec. & Mfg.
Company,
East Pittsburgh, Pa.

Kirk, W. B.,
Test Engineer,
Westinghouse Air Brake Company,
200 Delaware Ave.,
East McKeesport, Pa.

Kirkpatrick, H. F.,
Sales Department,
Union Steel Casting Co.,
62nd and Butler Sts.,
Pittsburgh, Pa

Kirkpatrick, R. L.,
Traction Apparatus Sales,
Westinghouse Elec. & Mfg. Company,
East Pittsburgh, Pa.

Kirsch, O. W.,
Asst. Train Master,
Pennsylvania Railroad,
1460 Foliage St.,
Wilkinsburg, Pa.

Kiser, Joseph A., Jr.,
Gang Fore., Car Dept.,
Union Railroad Co.,
R. F. D. No. 1,
Verona, Pa.

Klann, Peter B.,
Sub-Foreman,
Pressed Steel Car Co.,
801 Eleventh St.,
West Park,
McKees Rocks, Pa.

Klassen, Fred G.,
Round House Foreman,
P. & W. Va. Ry.,
27 Oakwood Road,
Pittsburgh (5), Pa.

Klein, Nicholas P.,
Foreman Car Repairs,
Pennsylvania Railroad,
50 South 33rd St.,
Pittsburgh, Pa.

Kleinhans, Harry,
President,
H. Kleinhans Co.,
419 Union Trust Bldg.,
Pittsburgh, Pa.

Kleinhans, L.,
519 East Gen. Robinson St.,
North Side,
Pittsburgh, Pa.

Knox, Wm. J.,
112 Second Ave.,
DuBois, Pa.

Kohl, H. J.,
Gen. Car Foreman,
P. & L. E. R. R.,
1106 Tweed St.,
Pittsburgh, Pa.

Kohute, Hilary Geo.,
Clerk,
Union Railroad,
East Pittsburgh, Pa

Kondej, Henry,
Tester,
Westinghouse Air Brake Co.,
353 Marguerite Ave.,
Wilmerding, Pa.

Kraus, Raymond E.,
Mechanical Draftsman,
P. & L. E. R. R.,
223 Fisk St.,
Arsenal Station,
Pittsburgh, Pa.

Krause, Harry A.,
Gang Fore., Penna. System,
160 Race St.,
Edgewood, Pittsburgh, Pa.

Krick, F. H.,
Trainmaster,
Pan Handle Division,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Kromer, Wm. F.,
Mechanical Engineer,
H. K. Porter Co.,
108 Tenth St.,
Aspinwall, Pa.

Kroske, J. F.,
Mgr., P. T. Sales,
Ingersoll-Rand Co.,
706 Chamber of Commerce Bldg.,
Pittsburgh, Pa.

Kruse, J. F. W.,
Supt., Woodings-Verona Tool Works,
528 Washington Ave.,
Oakmont, Pa.

Kulp, J. G.,
Train Master,
Pennsylvania Railroad,
Addison Hall,
Cambridge Court Apts.,
Edgewood, Pittsburgh, Pa.

Kummer, Jos. H.,
General Sales Representative,
Fort Pitt Mall. Iron Co.,
209 Greydon Ave.,
McKees Rocks, Pa.

Kusick, Harry F.,
Engineer,
Union Switch & Signal Co.
Swissvale, Pa.

Lackner, Ray A.,
District Sales Manager,
Penna. Forge Corp.,
5724 Bartlett St.,
Pittsburgh, Pa.

Ladd, Geo. T.,
President,
United Engineering & Fdy. Company,
First National Bk. Bldg.,
Pittsburgh, Pa.

Lally, C. V.,
General Manager of Sales,
Pgh. Steel Products Co.,
605 N. Negley Ave.,
Pittsburgh, Pa.

Lanahan, Frank J.,
President, Fort Pitt Malleable Iron Co.,
P. O. Box 492,
Pittsburgh, Pa.

Lanahan, J. S.,
Vice President, Fort Pitt Mall. Iron Co.,
127 Elysian Ave.,
Pittsburgh, Pa.

Landgraf, F. K.,
General Supt.,
Flannery Bolt Co.,
118 Crafton Ave.,
Crafton, Pa.

Landis, W. C.,
Asst. Works Manager,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Lang, W. C.,
Master Car Builders,
P. & L. E. R. R.,
McKees Rocks, Pa.

Larsen, Jacob C.,
Sales Engineer,
The Buckeye Steel Castings Co.,
So. Parsons Ave.,
Columbus, Ohio

Larsen, O. C.,
Secretary & Treasurer,
The North American Coal Corp.,
823 Wabash Bldg.,
Pittsburgh, Pa.

Laughner, Carl L.,
Gen'l Foreman, P. S. C. Co.,
1009 James St.,
N. S., Pittsburgh, Pa.

Laurent, Jos. A.,
Gen. Fore. Fin. Dept.,
Fort Pitt Mall. Iron Co.,
206 Bruce St.,
McKees Rocks, Pa.

Lawler, Joseph A.,
Sup't Trans.,
Carnegie Steel Co.,
Edgar Thomson Works,
Braddock, Pa.

Lawson, A. F.,
Foreman Painter,
P. & L. E. R. R.,
322 Reifert St.,
Pittsburgh, Pa.

Layng, Frank R.,
Chief Engineer,
P. & L. E. R. R.,
Greenville, Pa.

Leach, J. T.,
M. M., Penna. System.
1001 Broadway,
Juniata P. O.,
Altoona, Pa.

Leban, J. L.,
Ass't Dis't Supt.,
Pullman Co.,
1434 Gulf Bldg.,
Pittsburgh, Pa.

Lee, Elisha,
Vice President,
Penna. R. R. System,
Broad Street Station,
Philadelphia, Pa.

Lee, L. A.,
Supt. Telegraph,
P. & L. E. R. R.,
64 Terminal Annex Bldg.,
Pittsburgh, Pa.

Lees, Thomas,
Reymer & Brothers, Inc.,
123 Bascom St.,
Pittsburgh, (14) Pa.

Leet, C. S.,
Land Agent,
B. & L. E. R. R.,
P. O. Box 456,
Pittsburgh, Pa.

Lehr, Harry W.,
General Foreman,
Passenger Car Inspr's.,
P. R. R. Co.,
516 Arlington Apts.,
Center & Aiken Aves.,
Pittsburgh, Pa.

Leiper, C. I.,
Gen. Mgr., Central Region,
P. R. R. System,
Pennsylvania Station,
Pittsburgh, Pa.

Lewis, Goodrich Q.,
Chief Engineer,
W. H. Miner, Inc.,
209 South La Salle St.,
Chicago, Ill.

Lewis, Herbert,
Vice President,
Universal Packing Corp'n,
108 Smithfield St.,
Room 310,
Pittsburgh, Pa.

Lightsell, S. M.,
Boiler Foreman,
P. R. R.,
2674 Wind Gap Road,
Ingram, Pittsburgh, Pa.

Lindahl, A. M.,
Y. M., Union R. R.,
1732 Laketon Road,
Wilkinsburg, Pa.

Lindsay, J. H.,
Div. Accountant,
B. & O. R. R.,
1518 Center St.,
Wilkinsburg, Pa.

Linsenbigler, Allen J.,
Gang Foreman,
Union Railroad,
212 Dixon Ave.,
East Pittsburgh, Pa.

Lobez, P. L.,
Designing Engineer,
418 Swissvale Ave.,
Wilkinsburg, Pa.

Loeffler, George O.,
District Representative,
Climax Molybdenun Co.,
905 Union Trust Bldg.,
Pittsburgh, Pa.

Long, R. M.,
"Retired" Air Brake
Inspector and Instructor,
P. & L. E. R. R.,
3118 Pioneer Ave.,
South Hills Branch,
Pittsburgh, Pa.

Long, Walter,
Walter Long Mfg. Co.,
1313 Burgham St.,
S. S., Pittsburgh, Pa.

Longdon, Clyde V.,
Asst. Engineer, T. & E. D. Dept.,
Westinghouse Air Brake Co.
561 Broadway Extension,
East McKeesport, Pa.

Lorenzo, Dr. Frank,
Surgeon, B. & O. R. R.,
312 Union St.,
Punxsutawney, Pa.

Lortz, Elmer A.,
Safety Engineer,
Pressed Steel Car Co.,
3924 Winshire St.,
N. S., Pittsburgh, Pa.

Lower, N. M.,
President,
Lower Stoker Co.,
Hollins & McPhail Sts.,
Batlimore, Md.

Lowndes, T. H.,
Asst. Superintendent,
National Bearing Metals Corp.,
928 Shore Ave.,
N. S., Pittsburgh, Pa.

Lowry, Wm. F., Jr.
Sales Agent,
American Car & Foundry Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Luddy, Wm. E.,
E. H. Fore.,
Penna. R. R. System,
7704 Stanton St.,
Swissvale, Pa.

Ludgate, B. A.,
Consulting Engineer,
3421 Race St.,
Philadelphia, Pa.

Lundeen, Carl J.,
Office Asst. to General Agent,
P. & L. E. R. R.,
504 Union National Bank Bldg.,
Youngstown, Ohio

Lustenberger, L. C.,
Asst. to Asst. Gen'l Mgr. Sales, Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Lynch, Bernard J.,
Asst. Supervisor,
Mon. Con. R. R. Co.,
3202 Iowa St.,
Pittsburgh, Pa.

Lynn, Samuel,
Supt. of Rolling Stock,
P. & L. E. R. R.,
McKees Rocks, Pa.

Lynn, William,
General Car Foreman,
P. & L. E. R. R.,
Box 277, R. D. 3,
Coraopolis, Pa.

MacDonald, William C.,
Special Agent, Contracts,
Penna. R. R. System,
254 Allison Ave.,
Emsworth, Pa.

Mackert, A. A.,
Asst. to Design Engineer,
W. A. B. Co.,
450 Caldwell Ave.,
Wilmerding, Pa.

Maliphant, C. W.,
Test Dept.,
W. A. B. Co.,
101 Herman Ave.,
Wilmerding, Pa.

Mann, Henry S.,
Dist. Sales Mgr.,
Standard Stoker Co., Inc.,
1903 McCormick Bldg.,
Chicago, Ill.

Manning, Jas. F., Jr.,
As't R. F. of E.,
Penna. R. R.,
537 S. Graham St.,
E. E., Pittsburgh, Pa.

Manson, Arthur J.
Asst. Sales Manager,
Westinghouse Electric & Mfg. Co.,
700 Braddock Ave.,
East Pittsburgh, Pa.

Marquis, George E.,
Train Master,
P. & L. E. R. R. Co.,
702 Sixth Ave.,
New Brighton, Pa.

Marshall, Craig W.,
Eastern Sales Mgr.,
Sunbeam Elec. Mfg. Co.,
1720 Grand Cen. Terminal,
New York, N. Y.

Mason, S. O.,
Foreman,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Masterman, T. W.,
Asst. to Chief Design Engineer,
Westinghouse Air Brake Co.,
1249 McClure Ave.,
East McKeesport, Pa.

Masters, W. C.,
Technical Adviser, Bolt, Nut & Rivet Mfg. Ass'n.,
1520 Guardian Bldg.,
Cleveland, Ohio.

Matchneer, Wm. W.,
Sales Engineer,
Buckeye Steel Castings Co.,
Columbus, Ohio.

Matheny, George W.,
Yard Conductor,
P. & L. E. R. R.,
1808 Jenny Lind Ave.,
McKeesport, Pa

Matthews, R. J.,
Salesman,
Edgewater Steel Co.,
P. O. Box 249,
Pittsburgh, Pa.

Mauck, E. A.,
Air Brake Inspector,
Union Railroad,
Box 55,
North Bessemer, Pa.

Maxfield, Col. H. H.,
S. M. P., Southern Div.,
Penna. Railroad,
402 Pennsylvania Bldg.,
Wilmington, Del.

Maxwell, R. E.,
Wheel Engineer,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Mayer, L. I.,
Tester,
Westinghouse Air Brake Co.,
P. O. Box 384,
Wilmerding, Pa.

Meily, R. P.,
Trans. Mgr., Cent. Dist.,
Westinghouse Electric & Mfg. Co.,
Gulf Building,
Pittsburgh, Pa.

Meinert, Henry,
Locomotive Inspector,
Montour Railroad,
11 Geneva St.,
Etna, Pa.

Mercer, B. F.,
V. P. & Gen'l. Mgr.,
Union Steel Casting Co.,
62d and Butler Sts.,
Pittsburgh, Pa.

Merscher, John,
Foreman Car Repairs,
P. & L. E. R. R.,
348 Woodward Ave.,
McKees Rocks, Pa.

Mertz, G. H.,
Freight Agent., M. C. R. R.,
4035 Murray Ave.,
Pittsburgh, Pa.

Mertz, Jacob J.,
Gang Foreman Car Dept.,
P. & L. E. R. R.,
Main St.,
Glenwillard, Pa.

Michaels, John H.,
Yard Master,
Pennsylvania Railroad,
Freeport, Pa.

Milby, T. A.,
Investigator for the State Auditor General of Pa.,
307 Kearsarge St.,
Mt. Washington,
Pittsburgh, Pa

Millar, Clarence W.,
Mgr. Order Dept.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Miller, A. A.,
Chief Electrician,
Montour R. R. Co.,
5103 Holmes St.,
Pittsburgh, Pa.

Miller, George,
Piecework Inspector,
P. & L. E. R. R. Co.,
3228 Sacramento Ave.,
Pittsburgh, Pa.

Miller, J. Alfred,
Gen. Mgr. of Sales,
Vanadium Corp. of America,
P. O. Box 566,
Bridgeville, Pa.

Miller, J. F.,
Sales Engineer,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Miller, John,
Gen. Car Fore., Montour Railroad,
5127 Blair St.,
Hazelwood, Pa

Miller, L. L.,
Labor Foreman,
P. & L. E. R. R. Co.,
2900 Merwyn Ave.,
Pittsburgh, Pa.

Miller, R. C.,
General Superintendent,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Miller, W. H.,
Dining Car Agent,
Penna. R. R.,
1129 N. Highland Ave.,
Pittsburgh, Pa

Milliken, I. H.,
Vice Pres., McConway & Torley Corp'n.,
48th St. and A. V. Ry.,
Pittsburgh, Pa.

Mills, C. C.,
President & Gen. Manager,
Unity Railways Co.,
589 Union Trust Bldg.,
Pittsburgh, Pa

Minnick, F. G.,
308 Lincoln Ave.,
Bellevue, Pa.

Misklow, C. J.,
C. C. to Ast. to Train Master,
P. & W. Va. Ry.,
2 McMunn Ave.,
Crafton, Pa.

Misner, George W.,
Westinghouse Air Brake Co.,
304 Arlington Ave.,
East McKeesport, Pa.

Mitchell, Frank K.,
240 East End Ave.,
Beaver, Pa.

Mitchell, J. G.,
Sub-Storekeeper,
Union Railroad,
2 Duquesne Boulevard,
Kenmore Manor,
Kennywood, Pa.

Mitchell, W. S.,
Signal Inspector,
P. & L. E. R. R.,
540 River Road,
Beaver, Pa.

Mogan, John M.,
Asst. General Yard Master,
P. & L. E. R. R.,
119 Overbrook Blvd.,
Pittsburgh, Pa.

Moir, W. B.,
Chief Car Inspector,
Penna. Railroad,
1009 Penna. Station,
Pittsburgh, Pa.

Molyneaux, Dawes S.,
Sales Engineer,
Ft. Pitt Spring Co.,
Box 917,
Pittsburgh, Pa.

Monks, J. J.,
Freight Traffic Manager,
P. & L. E. R. R.,
Pittsburgh, Pa.

Montague, C. F.,
Supervisor,
Pennsylvania Railroad,
Homestead, Pa.

Montgomery, J. L.,
Assistant Auditor,
Union R. R.,
Frick Bldg. Annex,
Pittsburgh, Pa.

Montgomery, Wm. J.,
Railway Representative,
The Sherwin Williams Co.,
601 Canal Road,
Cleveland, Ohio.

Moore, Donald O.,
Mgr. of Traffic Div.,
Chamber of Commerce,
Chamber of Com. Bldg.,
Pittsburgh, Pa.

Morgan, A. L.,
Supt. on Special Duty,
Penna. R. R. System,
24 Maple Ave.,
Woodlawn,
Wheeling, W. Va.

Morgan, Homer C.,
Teller,
McKees Rocks Trust Co..
613 Frederick St.,
McKees Rocks, Pa.

Morris, A. T.,
Plant Manager,
American Chain Co.,
Braddock, Pa.

Morris, J. M.,
President & Gen. Mgr.,
The Lake Terminal
R. R. Co.,
McKeesport Connecting
R. R.,
1923 Frick Bldg.,
Pittsburgh, Pa.

Morrison, W. W.,
Chief Engineer,
Pittsburgh & Shawmut
Railroad,
Kittanning, Pa.

Moses, Graham Lee,
Elec. Engr., Westinghouse
Elec. & Mfg. Co.,
427 South Ave.,
Wilkinsburg, Pa.

Moxey, Arthur C.,
Sales Representative,
Butler Consolidated Coal Co.
311 W. Cunningham St.,
Butler, Pa.

Moyer, Oscar G. A.,
Engineer, Rieck-McJunkin
Dairy Co.,
2236 Lutz Ave.,
Mt. Oliver Station,
Pittsburgh, Pa.

Moyers Samuel G.,
Representative,
Mercury Manufacturing Co.,
Grant Building,
Pittsburgh, Pa.

Muir, Robert Y.,
Master Car Builder,
P. & W. Va. Ry Co.,
2431 Craftmont Ave.,
Crafton, Pa.

Mullally, Joseph W.,
District Manager,
Anaconda Wire & Cable
Co.,
Oliver Building,
Pittsburgh, Pa.

Mulvey, John I.,
Traffic Manager,
Hubbard & Co.,
6301 Butler St.,
Pittsburgh, Pa.

Munn, Alex D.,
First Aid Inspector,
P. & L. E. R. R.,
Glenwillard, Pa.

Murphy, Daniel,
Yardmaster, P. &. L. E. R. R.,
124 Fitler St.,
Mt. Oliver Sta.,
Pittsburgh (10), Pa.

Muse, Thos. Charles,
Traveling Car Agent,
P. & L. E. R. R.,
253 Fourth St.,
Beaver, Pa.

Myers, Arnold,
R. R. Equip't Inspector,
Carnegie Steel Co.,
R. F. D. 1, Box 338,
Homestead, Pa

Myers, Bernard E.,
Ass't Pass. Train Master,
Penna. R. R.,
7423 Penfield Place,
Pittsburgh, Pa.

Myers, R. C.,
Storekeeper,
Monongahela Ry. Co.,
Brownsville, Pa.

Myers, Walter H.,
Chief Clerk to Mech. Supt.,
Montour R. R. Co.,
P. O. Box 161,
West Bridgewater, Pa.

Myers, William F.,
Pressed Steel Car Co.,
326 Woodward Ave.,
West Park,
McKees Rocks, Pa.

McAbee, W. S.,
Vice Pres. & Gen. Supt.,
Union R. R.,
5239 Gertrude St.,
Pittsburgh, Pa.

McBeth, P. C.,
Sales Manager,
The Niles Tool Works Co.,
Grant Bldg.,
Pittsburgh, Pa.

McCarthy, F. W.,
Supt. Car Operation,
Pittsburgh Railways Co.,
435 Sixth Ave.,
Pittsburgh, Pa.

McCarthy, J. T.,
Ass't. Freight Train Master,
Penna. Railroad,
82 Duncan Ave.,
Crafton, Pa

McCartney, John H.,
District Manager,
Gustin-Bacon Mfg. Co.,
1021 Filbert St.,
Philadelphia, Pa.

McCauley, William,
R. F. of E., P. R. R. Co.,
577 Braddock Ave.,
Pittsburgh, Pa.

McClintock, John D.,
Manager, Injector Dept.,
Wm. Sellers & Co., Inc.,
1600 Hamilton St.,
Philadelphia, Pa.

McCloskey, J. C.,
Clerk, Union R. R. Co.,
2227 Woodstock Ave.,
Swissvale, Pa

McComb, R. J.,
Sales Manager,
Woodings-Verona Tool
Works,
Verona, Pa.

McConnell, Frank P.,
Yard Master,
P. & L. E. R. R.,
266 Shadowlawn Ave.,
Pittsburgh, (16) Pa.

McCoy, James M.,
Sales Engineer,
Lonsdale Mfg. Co.,
7716 Tuscarora St.,
Pittsburgh, Pa.

McCrea, James G.,
Brakeman,
Pennsylvania Railroad,
611 Pitt St.,
Wilkinsburg, Pa.

McCready, Arthur,
Gang Foreman,
Union Railroad,
821 Eleventh Ave.,
Munhall, Pa.

McCuen, J. T.,
Salesman, Motch & Merryweather Machinery Co.,
Clark Bldg.,
Pittsburgh, Pa.

McCully, D. L.,
Supervisor,
Westinghouse Air Brake Co.,
8001 Westmoreland St.,
Edgewood, Pa.

McCune, J. C.,
Asst. Director Engineering,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

McElravy, J. W.,
Terminal Agent,
P. & L. E. R. R.,
Terminal Annex Bldg.,
S. S., Pittsburgh, Pa.

McGaw, William L.,
Shop Foreman,
McKeesport Connecting R. R.,
1407 Manor Ave.,
McKeesport, Pa.

McGeorge, D. W.,
Secretary,
Edgewater Steel Co.,
P. O. Box 249,
Pittsburgh, Pa.

McGinley, T. A.,
President,
The Duff-Norton Mfg. Co.,
P. O. Box 555,
N. S., Pittsburgh, Pa.

McGinnis, Thomas P.,
District Sales Manager,
The Pyle-National Co,.
604 Chamber of
Commerce Bldg.,
Pittsburgh, Pa.

McGowan, Charles H.,
415 Jefferson Ave.,
Bellevue, Pa.

McHugh, C. A.,
Train Master,
P. & W. Va. Ry.,
21 Cannon St.,
Crafton, Pa.

McIlwain, J. P.,
Asst. Mgr.,
Central Warehouse,
P. & L. E. R. R.,
63 Greenbush St.,
Mt. Washingtoo Sta.,
Pittsburgh, Pa.

McIntyre, R. C.,
Master Mechanic,
Union Railroad,
7108 Penn Ave.,
Pittsburgh, Pa.

McKay, N. H.,
Mang'r., U. S. Chromium Corp'n.,
1100 Pitt St.,
Wilkinsburg, Pa.

McKedy, H. V.,
Rep., Railway Dept.,
The Patterson, Sargent Co.,
135 East 42nd St.,
New York, N. Y.

McKee, Frederick C.,
Pres., Winfield R. R.,
2215 Oliver Bldg.,
Pittsburgh, Pa.

McKee, S. Frank,
Asst. to Gen. Mgr.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

McKelvey, J. E.,
Asst. Gen. Mgr. Sales,
Neeley Nut & Bolt Co.,
21st and Wharton Sts.,
Pittsburgh, Pa.

McKenzie, Edward F.,
A. B. Instructor, Penna. R. R.,
7934 Susquehanna St.,
Pittsburgh, Pa.

McKinley, Archie J.,
Chief Motive Power Inspector,
P. & L. E. R. R.,
613 Broadway Ave.,
McKees Rocks, Pa.

McKinley, John T.,
Report Clerk,
P. & L. E. R. R.,
613 Broadway Ave.,
McKees Rocks, Pa.

McKinstry, C. H.,
Ass't., Research Engineer,
W. A. B. Co.,
46 Sprague St.,
Wilmerding, Pa.

McKinzie, Edward,
General Yard Master,
P. & W. Va. Ry.,
R. D. 8, Crafton, Pa.

McLain, J. E.,
Special Representative,
Bethlehem Steel Co.,
1214 Oliver Bldg.,
Pittsburgh, Pa.

McLaughlin, Howard B.,
R. F. of E.,
P. & L. E. R. R.,
2947 Merwyn Ave.,
Corliss Station,
Pittsburgh, Pa.

McMillan, A. P.,
Boiler Foreman,
P. & W. Va. Ry.,
413 E. Main St.,
Carnegie, Pa.

McMillen, Harry,
Car Inspector,
P. & L. E. R. R.,
517 Fourth St.,
Braddock, Pa.

McMullen, Clark E.,
Inspector Transportation,
P. & L. E. R. R. Co.,
P. & L. E. Terminal
Bldg.,
Pittsburgh, Pa.

McNamee, William W.,
District Manager,
Briggs & Turivas Co.,
41 Marion St.,
Crafton, Pa.

McNelty, A. P.,
Car Distributor,
P. & L. E. R. R.,
2950 Voelkel Ave.,
Dormont, Pittsburgh, Pa.

McPherson, A. R.,
Train Master,
Montour Railroad,
1711 State Ave.,
Coraopolis, Pa.

McQuillen, J. J.,
President,
Universal Packing Corp.,
108 Smithfield St.,
Pittsburgh, Pa.

Nagel, James,
Supt. Transportation,
Montour Railroad,
1711 State St.,
Coraopolis, Pa.

Nannah, F. J.,
Engr. Maintenance of Way,
P. & L. E. R. R.,
Pittsburgh, Pa.

Nash, R. L.,
Test Engr., Test Division,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Neff, John P.,
Vice President,
American Arch Co.,
60 E. 42nd St.,
New York, N. Y.

Ness, H. S.,
Agent,
B. & O. R. R.,
N. S., Pittsburgh, Pa.

Nethken, H. W.,
Vice President,
Pgh. & West Va. R. R.,
405 Wabash Bldg.,
Pittsburgh, Pa.

Newell, J. P., Jr.,
Supervisor Track,
Pennsylvania Railroad,
East Liberty Freight
Station,
Pittsburgh, Pa.

Nieman, Charles J.,
Secretary-Treasurer,
Penn Iron & Steel Co.,
Creighton, Pa.

Nieman, H. L.,
Gang Foreman,
P. & L. E. R. R.,
208 Copeland St.,
McKees Rocks, Pa.

Noble, Jesse A.,
Supv'r Bridges & Bldgs.,
P. & L. E. R. R.,
1643 Broadway,
McKees Rocks, Pa.

Noonan, W. T.,
Vice President,
B. & O. R. R. System,
155 West Main St.,
Rochester, N. Y.

Norris, J. L.,
R. F. of E., B. & O. R. R.,
4818 Chatsworth St.,
Pittsburgh, Pa.

Nutt, Col. H. C.,
Pres. & Gen. Mgr.,
Monongahela Ry. Co.,
Century Bldg.,
Pittsburgh, Pa.

Oberlin, A. C.,
Auditor,
Schaefer Equipment Co.,
Koppers Building,
Pittsburgh, Pa.

O'Boyle, Charles M.,
President,
Royal Railway Supply Co.,
250 Park Ave.,
New York, N. Y.

O'Brien, Martin J.,
President,
Martin J. O'Brien Co., Inc.,
512 Columbia Bldg.,
Pittsburgh, Pa.

O'Connor, M. J.,
Rep., Dearborn Chemical Co.,
618 Farmers Bank Bldg.,
Pittsburgh, Pa.

Ogden, George D.,
Vice President, New England,
Pennsylvania Railroad,
80 Federal St.,
Boston, Mass.

O'Leary, Jeremiah J.,
Machinist, Penna. System,
132 Fourth St.,
Oakmont, Pa.

Orbin, George N.,
Retired,
Engineman, B. & O. R. R.,
2945 Glenmore Ave.,
Dormont, Pittsburgh, Pa.

Orbin, John N.,
District Manager,
Oliver Iron & Steel
Corp.,
10th and Murial Sts.,
Pittsburgh, Pa.

Orchard, Charles,
5849 Hobart St.,
Pittsburgh, Pa.

Orr, D. K.,
Superintendent,
The Monongahela Ry. Co.,
Brownsville, Pa.

Osborne, H. C.,
Supvr. of Water Supply,
P. & L. E. R. R.,
250 Wilson Ave.,
Beaver, Pa.

Osborne, William J.,
Gen. Elec. Fore., Union R. R.,
8 Norman St.,
Duquesne, Pa.

O'Sullivan, John J.,
Pipe Fitter, P. & L. E. R. R.,
1130 Wayne Ave.,
McKees Rocks, Pa.

O'Toole, J. L.,
Ass't. to Gen. Manager,
P. & L. E. R. R.,
Pittsburgh, Pa.

O'Toole, Thomas J.,
Clerk, B. & O. R. R. Co.,
2211 Los Angeles Ave.,
Pittsburgh, Pa.

Owen, A. T.,
Supt. Transportation,
Reading Company,
Reading Terminal,
Philadelphia, Pa.

Painter, Joseph,
Railway Equipment,
424 Fourth Ave.,
Pittsburgh, Pa.

Paisley, F. R.,
Inspecting Engineer,
P. & L. E. R. R. Co.,
1111 Stanford Road,
N. S., Pittsburgh, Pa.

Palmer, E. A.,
Traction Apparatus Sales,
Westinghouse Elec. &
Mfg. Company,
564 East End Ave.,
Pittsburgh, Pa.

Park, Charles L.,
Salesman,
Goodall Rubber Co.,
61 Water St.,
Pittsburgh, Pa.

Parker, William, Jr.,
Asst. Master Mechanic,
Pennsylvania Railroad,
7215 Perrysville Ave.,
Ben Avon, Pa

Paschold, Curtis H.,
Claim Agent,
Legal Dept.,
Penna. R. R.,
417 Chestnut Rd.,
Sewickley, Pa.

Passmore, H. E.,
Representative,
Hanna Stoker Co.,
5668 Darlington Road,
Pittsburgh, Pa.

Patterson, Fred W.,
Consulting Engineer,
1500 Third Ave.,
New Brighton, Pa.

Patterson, John W.,
District Sales Manager,
Western Wheeled Scraper Co.,
324 Fourth Ave.,
Pittsburgh, Pa.

Paul, Lesley C.,
Manager, Publicity Bureau,
W. E. & Mfg. Co.,
217 Woodside Road,
Forest Hills Boro.,
Pittsburgh (21) Pa.

Peabody, Reuben T.,
Railroad Sales Assistant,
Air Reduction Sales Co.,
60 East 42nd St.,
New York, N. Y.

Pehrson, A. K.,
Mech. Engr.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Penton, John A.,
Pres., The Penton Pub. Co.,
Cleveland, Ohio.

Peoples, James S.,
Freight T. M., P. R. R. Co.,
2610 N. Sixth St.,
Harrisburg, Pa.

Peterson, William M.,
Yard Master,
P. & L. E. R. R.,
1404 Pirl St.,
McKeesport, Pa.

Pickard, S. B.,
Chief Electrician,
P. & L. E. R. R.,
604-A Broadway,
McKees Rocks, Pa.

Pillar, Michael,
Piece Work Inspector,
P. & L. E. R. R.,
206 Jane St.,
McKees Rocks, Pa.

Platt, J. G.,
Pres. and Gen. Manager,
Hunt-Spiller Mfg. Corp.,
383 Dorchester Ave.,
So. Boston, Mass.

Poffenberger, J. C.,
Supt., Maryland Div.,
Pennsylvania Railroad,
Wilmington, Del.

Pollock, J. H.,
Boiler Foreman,
Montour Railroad,
Fifth Ave.,
Coraopolis, Pa.

Pomeroy, William McL.,
General Freight Agent,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Posteraro, S. F.,
Frt. Cashier,
B. & O. R. R.,
Grant and Water Sts.,
Pittsburgh, Pa.

Pringle, Arthur D.,
Supvr. Wage Schedule,
Monongahela Railway,
609 Water St.,
South Brownsville, Pa.

Pringle, H. C.,
Supt., Mon. Con. R. R.,
McCully St. & Marlin Drive,
Mt. Lebanon, Pittsburgh, Pa.

Pringle, J. L.,
Freight Train Master,
Pennsylvania Railroad,
513 Pennsylvania Sta.,
Pittsburgh, Pa.

Pringle, P. V.,
Commercial Engineer,
Westinghouse Air Brake Co.,
811 South Ave.,
Wilkinsburg, Pa.

Provost, S. W.,
Representative,
American Locomotive Co.,
2116 Farmers Bank Bldg.,
Pittsburgh, Pa.

Pugh, Andrew J.,
District Sales Manager,
Homestead Valve Mfg. Co.,
Box "H,"
Coraopolis, Pa.

Pugh, Clifford F.,
Ry. Watch Inspector,
Pugh Bros.,
House Bldg.,
Pittsburgh, Pa.

Pumphrey, C. H.,
Freight Traffic Manager,
B. & O. R. R.,
Oliver Bldg.,
Pittsburgh, Pa.

Pye, David W.,
President,
Tuco Products Corp.,
30 Church St.,
New York, N. Y.

Queer, Thomas H.,
Sales Engineer,
Pittsburgh Coal Co.,
Oliver Building,
Pittsburgh, Pa.

Ralston, John A.,
Mech. Engr., U. R. R. Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Rambo, Jay B.,
Train Master,
Long Island Railroad,
19 Pamnanake Ave.,
Babylon,
Long Island, N. Y.

Rankin, B. B.,
Asst. Gen. Auditor,
P. & L. E. R. R.,
1502 Park Blvd.,
Dormont,
Pittsburgh, Pa.

Rankin, Roy S.,
Dist. Representative,
Hachmeister-Lind Co.,
R. D. No. 2,
Coraopolis Heights,
Coraopolis, Pa.

Raser, Geo. B.,
5614 Walnut St.,
E. E., Pittsburgh, Pa.

Rauschart, E. A.,
Mechanical Supt.,
Montour Railroad,
1711 State Ave.,
Coraopolis, Pa.

Raymer, I. S.,
Signal Engineer,
P. & L. E. R. R.,
959 Fourth Ave.,
Beaver, Pa.

Read, A. A.,
Duquesne Slag Products Co.,
806 Diamond Bank Bldg.,
Pittsburgh, Pa.

Ream, A. H.,
S. M. P. & E.,
P. & S. R. R.,
Brookville, Pa.

Record, J. Fred,
Supt. of Production,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Redding, P. E.,
Sales Engineer,
Johns-Manville, Inc.,
Clark Bldg.,
Pittsburgh, Pa.

Redding, R. D.,
General Foreman,
P. & L. E. R. R. Co.,
Campbell, Ohio.

Reed, J. B.,
Treas. & Tax Collector,
Stowe Township,
550 Broadway,
McKees Rocks, Pa.

Reeve, George,
Foreman Electrical Dept.,
Ft. Pitt Malleable Iron Co.,
330 Woodward Ave.,
McKees Rocks, Pa.

Regan, W. J.,
Mechanical Engineer,
McConway & Torley
Corp'n.
48th St. & A. V. Ry.,
Pittsburgh, Pa.

Reifsnyder, J. W.,
Engineer of Tests,
Pgh. Testing Laboratory,
P. O. Box 1115,
Pittsburgh, Pa.

Renshaw, W. B.,
Representative,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Rhine, George B.,
Engine House Foreman,
Pennsylvania Railroad,
104 Brownsville Road,
Mt. Oliver,
Pittsburgh, Pa.

Richardson, H. R.,
Suprv. of Wage Schedules,
P. & L. E. R. R.,
Pittsburgh, Pa.

Rieker, H. M.,
Freight Agent,
P. & L. E. R. R.,
23rd Street,
S. S., Pittsburgh, Pa.

Rill, John C.,
General Manager,
Pennsylvania Railroad,
Western Region,
Chicago, Ill.

Ritts, Wm. H.,
Steam Engineer,
Spang, Chalfant & Co.,
1 Pine St.,
Etna, Sharpsburg Sta., Pa.

Rizzo, C. M.,
Agent, P. & W. Va. Ry.,
Box 206,
Castle Shannon, Pa.

Roan, Harry E.,
Fore., Loco. & Crane Repairs,
Jones & Laughlin Steel Corp.,
1024 Franklin Ave.,
Aliquippa, Pa.

Robertson, Harold,
Yard Master,
P. & L. E. R. R.,
111 West Apple St.,
Connellsville, Pa.

Robinson, John M.,
Engr., Ry. Engr. Dept.,
Westinghouse Elec. &
Mfg. Co.,
6100 Bryant St.,
Pittsburgh, Pa.

Robinson, R. L.,
Sales Representative,
The American Brake Shoe
& Foundry Co.,
714 Roselawn Ave.,
S. H. B., Pittsburgh, Pa.

Rogan, John A.,
Special Engineer,
Pgh. Railways Co.,
Park Way Office,
N. S., Pittsburgh, Pa.

Roney, H. E.,
Sig. Draftsman,
P. & L. E. R. R.,
3111 College Ave.,
Beaver Falls, Pa.

Root, E. E.,
Master Mechanic,
D. L. & W. R. R. Co.,
50 North Munn Ave.,
East Orange, N. J.

Rose, A. J.,
Salesman,
Greenville Steel Car Co.,
Greenville, Pa.

Rossell, R. T.,
President, B. & L. E. R. R.,
Union Trust Building,
Pittsburgh, Pa.

Rowles, H. N.,
Asst. Train Master,
Pennsylvania Railroad,
2700 Broadway,
South Hills,
Pittsburgh, Pa.

Rudd, W. B.,
General Engineer,
Union Switch & Signal Co.,
Swissvale, Pa.

Rumbarger, F. A.,
1847 Koppers Bldg.,
Pittsburgh, Pa.

Rupp, Edwin S.,
C. C. to Div. Accountant,
B. & O. R. R.,
220 Virginia Ave.,
Mt. Washington,
Pittsburgh, Pa.

Rushneck, George L.,
Draftsman,
P. & L. E. R. R.,
McKees Rocks, Pa.

Ryan, D. W.,
Chief Clerk, Order Dept.,
Ft. Pitt Malleable Iron Co.,
3138 Landis St.,
Pittsburgh, Pa.

Ryan, Frank J.,
District Representative,
Detroit, Toledo & Ironton R. R.,
1106 Clark Bldg.,
Pittsburgh, Pa.

Rys, C. F. W.,
Assistant to President,
Carnegie Steel Co.,
517 Carnegie Bldg.,
Pittsburgh, Pa.

Saltic, Thomas,
Foreman,
Ft. Pitt Malleable Iron Co.,
321 Russellwood Ave.,
McKees Rocks, Pa.

Sample, W. E.,
Supv'r Loco. Operation,
B. & O. R. R.,
Pittsburgh, Pa.

Sanders, Major Walter C.,
Gen. Mgr., Ry. Div.,
Timken Roller Bearing Co.,
Canton, Ohio.

Sattley, E. C.,
Vice President,
The Champion Sales Co.,
604 Chamber of Commerce Bldg.,
Pittsburgh, Pa

Sauer, George L.,
Freight Agent,
P. & L. E. R. R.,
McKeesport, Pa.

Sawhill, Don M.,
Sawhill Mfg. Co.,
Oliver Bldg.,
Pittsburgh, Pa.

Sawyer, R. W.,
Salesman,
Penna. & Ohio Lumber Co.,
2203 Oliver Bldg.,
Pittsburgh, Pa.

Sayre, Frank N.,
Train Master,
Alipuippa & So. R. R.,
112 Orchard St.,
Aliquippa, Pa.

Schaefer, Frederic,
Schaefer Equipment Co.,
Koppers Bldg.,
Pittsburgh, Pa.

Schaeffer, F. E.,
Asst. Manager of Sales,
Union Spring & Mfg. Co.,
2001 Clark Bldg.,
Pittsburgh, Pa.

Schaffer, W. E.,
Back Shop Foreman.
P. & W. Va. Ry.,
242 Boden Ave.,
Carnegie, Pa.

Schaller, Andrew J.,
Asst. Supervisor,
Pennsylvania Railroad,
667 Highland Ave.,
Johnstown, Pa.

Schiller, John,
Cond'r., P. & W. Va. R. R.,
528 Climax St.,
Pittsburgh, (10) Pa.

Schmeltz, Oliver B.,
Salesman,
Arch Machinery Co., Inc.,
Park Building,
Pittsburgh, Pa.

Schmied, Fred J.,
Foreman,
Railway Service & Supply
Corporation,
302 Russellwood Ave.,
McKees Rocks, Pa.

Schmitt, Raymond F.,
Clerk,
Mon. Con. R. R. Co.,
1531 Hoff St.,
N. S., Pittsburgh, Pa.

Schmoll, G. A.,
Supvr. Loco. Maintenance,
B. & O. R. R.,
Baltimore, Md.

Schoch, M. G.,
Asst. Freight Trainmaster,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Schoen, W. H., Jr.,
Vice President,
Pgh. Knife & Forge Co.,
926 Farmers Bank Bldg.,
Pittsburgh, Pa.

Schrader, A. P.,
Asst. to Mgr. Transp'n.
Sales,
Westinghouse Elec. &
Manufacturing Co.,
East Pittsburgh, Pa.

Schrecongost, C. P.,
Traffic Manager,
Hillman Coal & Coke Co.,
First Nat. Bank Bldg.,
Pittsburgh, Pa.

Schuchman, W. R.,
President,
Homestead Valve Mfg. Co.,
Coraopolis, Pa.

Schultz, Harry P.,
General Yard Master,
P. & L. E. R. R.,
2714 Fifth Ave.,
Beaver Falls, Pa.

Schwab, J. B.,
Audit Clerk,
Pressed Steel Car Co.,
1808 Rhine St.,
N. S., Pittsburgh, Pa.

Schwer, Leo D.,
Gang Foreman,
Penna. R. R. System,
R. F. D. No. 1,
Verona, Pa.

Searles, E. J.,
Manager,
Schafer Equipment Co.,
Koppers Bldg.,
Pittsburgh, Pa.

Seibert, Wm. L.,
Engine House Foreman,
P. & L. E. R. R.,
327 Russellwood Ave.,
McKees Rocks, Pa.

Seiss, W. C.,
Car Inspector,
P. C. C. & St. L. Ry. Co.,
507 Justus Avenue,
Carnegie, Pa.

Sekera, Charles J.,
Tester, Engine Dept.,
Westinghouse Air Brake Co.,
437 Short St.,
East McKeesport, Pa.

Semethy, Joseph J.,
Asst. Fore., Dept. D. M.,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Semmer, M. R.,
Salesman,
Air Reduction Sales Co.,
?81 Dixon Ave.,
South Hills Branch,
Pittsburgh, Pa.

Seroky, E. A.,
Asst. Shipper,
Fort Pitt Malleable Iron Co.,
838 Russellwood Ave.,
McKees Rocks, Pa.

Severn, A. B.,
Sales Engineer,
A. Stucki Co.,
419 Oliver Bldg.,
Pittsburgh, Pa.

Shafer, J. S.,
Safety Inspector,
Union Railroad,
Linden Ave.,
East Pittsburgh, Pa.

Shannon, David E.,
Employment Agent,
Ft. Pitt Malleable Iron Co.,
P. O. Box 1054,
Pittsburgh, Pa.

Shannon, Wallace R.,
Train Rules Examiner,
P. & L. E. R. R.,
3111 Pioneer Ave.,
Dormont,
Pittsburgh, Pa.

Sharp, H. W.,
Mechanical Engineer,
6619 Shetland St.,
E. E., Pittsburgh, Pa.

Sharp, James,
M. M., McKeesport Con. R. R.,
4820 Main St.,
Homestead, Pa.

Shaw, George M.,
Sales Representative,
Standard Steel Car Corp.,
Box 248,
Baltimore, Md.

Shaw, John,
Road Master,
B. R. & P. Ry.,
404 Indiana St.,
Punxsutawney, Pa.

Shay, H. J.,
Machinist,
Penna. Railroad,
Room 306, Federal St. Station,
N. S., Pittsburgh, Pa.

Sheets, Harry E.,
Traffic Manager,
Montour Railroad,
8 Market St.,
Pittsburgh, Pa.

Shellenbarger, Herbert M.,
Com. Engr., W. A. B. Co.,
184 W. Hutchinson Ave.,
Edgewood, Pa.

Shelly, DeWitt L.,
Shop Engineer,
Westinghouse Air Brake Co.,
353 Marquerite Ave.,
Wilmerding, Pa.

Sheridan, Thos. F.,
Asst. to S. M. P. & S. R. S.,
P. & L. E. R. R.,
McKees Rocks, Pa.

Shield, Arthur,
Asst. Auditor Freight Acc'ts,
P. & L. E. R. R.,
1230 Penn Ave.,
New Brighton Pa.

Shirey, Don. B.,
T. M., Union R. R.,
East Pittsburgh, Pa.

Showalter, Joseph,
Boiler Maker Foreman,
Aliquippa & Southern R. R.,
116 Carrol St.,
Aliquippa, Pa.

Shuck, Wm. C.,
Salesman,
Lockhart Iron & Steel Co.,
P. O. Box 1243,
Pittsburgh, Pa.

Shull, George S.,
President,
Safety First Supply Co.,
Brady Bldg.,
Pittsburgh, Pa.

Shultz, G. J.,
Gang Fore., Penna. System,
1052 Berg St.,
Johnstown, Pa.

Sieger, Hillard J.,
Yard Master,
P. & L. E. R. R.,
183 St. Joseph St.,
Mt. Oliver, Pittsburgh, Pa.

Sievert, W. H.,
Salesman,
James B. Sipe & Co.,
1322 Juniata St.,
N. S., Pittsburgh, Pa.

Simons, Philip,
Traffic Manager,
Copperweld Steel Co.,
Glassport, Pa.

Sinclair, I. B.,
Supt., Pgh. Div.,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Siner, Thomas E.,
Camden Forge Co.,
5442 Wayne Ave.,
Germantown,
Philadelphia, Pa.

Sixsmith, G. M.,
Superintendent,
Pennsylvania Railroad,
Room 211, Penna. Station,
Pittsburgh, Pa.

Sladden, F. T.,
A. G. F. A., P. & L. E. R. R.,
Pittsburgh, Pa.

Slick, Frank F.,
Asst. Gen. Supt.,
Edgar Thomson Works,
C. S. Co.,
Braddock, Pa.

Smith, E. E.,
General Manager,
Scott Haven Coal Co.,
415 Pitt St.,
Wilkinsburg, Pa.

Smith, E. W.,
Receiver,
Seaboard Air Line,
Norfolk, Va.

Smith, Frederic M.,
106 Second St.,
Ellwood City, Pa.

Smith, H. H.,
Traffic Manager,
American Sheet & Tin
Plate Co.,
Frick Bldg.,
Pittsburgh, Pa.

Smith, Homer K.,
Asst. Supt., Ry. & Loco. Depts.,
Westinghouse Elec. &
Mfg. Co.,
1213 La Clair Ave.,
Swissvale, Pa.

Smith, J. Frank,
Gang Foreman,
Union Railroad,
141 Brown Ave.,
Turtle Creek, Pa.

Smith, M. A.,
General Manager,
P. & L. E. R. R.,
Pittsburgh, Pa.

Smith, M. S.,
Purchasing Agent & Gen. Storekeeper,
Monongahela Railway Co.,
Brownsville, Pa.

Smith, Ralph W.,
Sales Engineer,
S. W. Straus & Co.,
600 South 49th St.,
Philadelphia, Pa.

Smith, Walter S.,
Gang Foreman,
P. & L. E. R. R.,
Dawson, Pa.

Snitehurst, James G.,
Engine House Foreman,
Pennsylvania Railroad,
707 Orchard Ave.,
Avalon, Pa.

Snyder, F. I.,
Vice Pres. & General Mgr.,
B. & L. E. R. Co.,
Box 456,
Pittsburgh, Pa.

Snyder, J. C.,
Vice President,
Standard Steel Car Corp.,
Gulf Bldg.,
Pittsburgh, Pa.

Snyder, J. J.,
Coal Freight Agent,
P. & L. E. R. R.,
Pittsburgh, Pa.

Sparks, Hynes,
Sales Department,
The Symington Co.,
230 Park Ave.,
New York, N. Y.

Spinning, Charles F.,
335 Fifth Ave.,
Pittsburgh, Pa.

Stackhouse, R. K.,
Gen. Supt. Stations, Transfers,
Penna. R. R.,
1636 Broad St. Station Building,
Philadelphia, Pa.

Stafford, Samuel G.,
President,
Vulcan Crucible Steel Co.,
Aliquippa, Pa.

Stamets, William K.,
4026 Jenkins Arcade,
Pittsburgh, Pa.

Stamm, B. B.,
Draftsman,
Canton Car Co.,
410 McKinley Ave.,
Butler, Pa.

Stark, F. H.,
Retired,
702 Main St.,
Coraopolis, Pa.

Stearns, Leo C.,
Car Inspector,
P. & L. E. R. R.,
410 Monongahela Ave.,
Glassport, Pa.

Stearns, W. G.,
Car Inspector,
P. & L. E. R. R.,
1112 Soles St.,
McKeesport, Pa.

Stebler, W. J.,
Vice President,
Pennsylvania Conley Tank Car Co.,
Koppers Building,
Pittsburgh, Pa.

Stein, J. A.,
Air Brake Instructor,
Pennsylvania Railroad,
Youngwood, Pa.

Stephen, James,
Foreman, Carpenter Shop,
Montour Railroad,
620 Vine St.,
Coraopolis, Pa

Stephenson, G. C.,
Manager,
Koppers Products Co.,
Koppers Bldg.,
Pittsburgh, Pa.

Sterling, C. C.,
Engine House Foreman,
Union R. R.,
339 Albert St.,
Turtle Creek, Pa.

Stevens, L. V.,
President,
Fort Pitt Stoker Co.,
35 Water St.,
Pittsburgh, Pa.

Stevens, R. R.,
Asst. Design Engineer,
Westinghouse Air Brake Company,
5 Elmore Road,
Wilkinsburg, Pa.

Stewart, K. C.,
Chief Engineer,
Canton Car Co.,
214 American Ave.,
Butler, Pa.

Stewart, L. R.,
R. F. of E.,
Pennsylvania Railroad,
108 Fifth Ave.,
Carnegie, Pa.

Stewart, W. W.,
Branch Manager,
Koppel Industrial Car & Equipment Co.,
629 Peoples Gas Bldg.,
Chicago, Ill.

Stiles, Lawson A.,
Baggage Agent,
P. & L. E. R. R.,
P. & L. E. Terminal,
Pittsburgh, Pa.

Stillwagon, Charles K.,
Superintendent,
Davis Brake Beam Co.,
R. D. 5, Box 67,
Johnstown, Pa.

Stine, D. H.,
Asst. R. F. of E.,
Pennsylvania Railroad,
Allegheny Shops,
N. S., Pittsburgh, Pa.

Stiver, Joseph R.,
Conductor,
B. R. & P. Ry.,
104 Cypress St.,
Punxsutawney, Pa.

Stoecker, P. J.,
Pittsburgh Steel Co.,
Union Trust Bldg.,
Pittsburgh, Pa.

Stoffregen, Louis E.,
Draftsman,
P. & L. E. R. R.,
804 Southern Ave.,
Mt. Washington,
Pittsburgh, Pa.

Storer, N. W.,
Consulting Rwy. Engineer,
Westinghouse Elec. & Manufacturing Co.,
East Pittsburgh, Pa.

Stritzinger, Frank,
Wheel Insp'r., P. & L. E. R. R.,
117 Stem St.,
Wabash Station,
Pittsburgh, Pa.

Stucki, A.,
Engineer,
419 Oliver Bldg.,
Pittsburgh, Pa.

Stuebing, A. F.,
Scarsdale, N. Y.

Suckfield, G. A.,
Asst. Chief Engr., F. C. D.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Sullivan, Ambrose W.,
Sales Agent,
American Locomotive Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Sullivan, P. W.,
Supt., Eastern Div.,
Pennsylvania Railroad,
206 Pennsylvania Sta.,
Pittsburgh, Pa.

Sutherland, Lloyd,
Gen. Storekeeper,
P. & L. E. R. R.,
124 Greydon Ave.,
McKees Rocks, Pa.

Suydam, R. S.,
President,
M. B. Suydam Co.,
Island & Preble Aves.,
N. S., Pittsburgh, Pa.

Swanson, Carl A.,
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P. & L. E. R. R.,
468 Irvin Ave.,
Rochester, Pa.

Swope, Bruce M.,
Supt. Motive Power,
Pennsylvania Railroad,
132 Emerson Ave.,
Aspinwall, Pa.

Sykes, Arthur H.,
Safety Agent,
P. & L. E. R. R.,
707 Florida Ave.,
Mt. Lebanon,
Pittsburgh, Pa.

Sylvester, H. G.,
Mgr. Central Warehouse,
P. & L. E. R. R.,
Pittsburgh, Pa.

Symons, F. E.,
President,
The Ralston Steel Car Co.,
Columbus, Ohio

Tarr, H. S.,
Foreman,
Union Railroad,
516 North Ave.,
Wilkinsburg, Pa.

Tate, James B.,
Purchasing Agent,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Tate, M. K.,
Manager of Service,
Lima Locomotive Works,
Inc.,
Lima, Ohio

Tate, Ralph H.,
Vice President,
Fort Pitt Spring Co.,
P. O. Box 917,
Pittsburgh, Pa.

Taylor, H. G.,
Pres., Ball Chemical Co.,
Fulton Bldg.,
Pittsburgh, Pa.

Taylor, Joseph M.,
Asst. to President,
Ball Chemical Co.,
1201 Fulton Bldg.,
Pittsburgh, Pa.

Taylor, Leonard C. G.,
Car Inspector,
Penna. Railroad,
1901 Marmaduke St.,
N. S., Pittsburgh, Pa.

Temple, H. H.,
C. Engr., P. & W. Va. Ry.,
Wabash Bldg.,
Pittsburgh, Pa.

Terrill, Elmer F.,
Engineering Division,
General Contracting Corp.,
P. O. Box 82,
Belle, W. Va.

Thomas, Frank B.,
Chief General Engineer,
W. A. B. Co.,
2 Newport Road,
Forest Hills,
Wilkinsburg, Pa.

Thomas, Harold N.,
Inspector,
Carnegie Steel Co.,
5908 Rural St.,
Pittsburgh, Pa.

Thomas, T. T.,
Foreman,
Union Railroad Co.,
422 Albert St.,
Turtle Creek, Pa.

Thompson, Harry T.,
District Manager,
Thermit Department,
Metal & Thermit Corp.,
1514 North Ave., West,
N. S., Pittsburgh, Pa.

Thornton, A. W.,
Resident Engineer,
P. & L. E. R. R.,
Terminal Bldg.,
Pittsburgh, Pa.

Thornton, Sir Henry W.,
Chairman & President,
Canadian National Rwys.,
360 McGill St.,
Montreal, Quebec, Canada

Tipton, George M.,
Agent, B. & O. R. R.,
Braddock, Pa.

Tomasic, Joseph D.,
Machinist,
Pennsylvania Railroad,
505 Greensburg Pike,
Turtle Creek, Pa.

Tomasic, Nicholas M., Jr.,
Locomotive Mechanic,
Pennsylvania Railroad,
122 Seventh St.,
Turtle Creek, Pa.

Touceda, Prof. Enrique,
Consulting Engineer,
943,
Albany, N. Y.

Toussaint, R.,
Chief of Police,
P. & L. E. R. R.,
Pittsburgh, Pa.

Tovey, G. F.,
Asst. Train Master,
Aliquippa & Southern R. R.,
1213 Boundry St.,
Aliquippa, Pa.

Trainer, M. N.,
Asst. Vice President,
American Brake Shoe & Fdy.
Company,
230 Park Ave.,
New York, N. Y.

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Briggs & Turivas,
R. D. No. 2,
Coraopolis, Pa.

Trax, Louis R.,
Inspector,
Union Railroad,
110 Sixth St.,
Turtle Creek, Pa.

Triem, W. R.,
Supt., Freight Transp'n.,
Pennsylvania Railroad,
1236 Winterton St.,
Pittsburgh, Pa.

Trust, C. W.,
Asst. Traffic Mgr.,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Tucker, Jas W.,
Division Storekeeper,
B. & O. R. R.,
Box 166,
Chillicothe, Ohio

Tucker, John L.,
"Retired" Trainmaster,
Pennsylvania Railroad,
5512 Center Ave.,
Pittsburgh, Pa.

Turner, F. M.,
General Superintendent,
A. & S. S. R. R. Co.,
Cor. 10th and Muriel Sts.,
S. S., Pittsburgh, Pa.

Tuttle, C. L.,
Mech. Engr., B. & L. E. R. R.,
15 Shady Ave.,
Greenville, Pa.

Tyrie, Robert M.,
Loco. Engineer,
Montour Railroad,
815 Ferree St.,
Coraopolis, Pa.

Ufer, C. E.,
Pres., Penna. & Ohio
Lumber Co.,
2203 Oliver Bldg.,
Pittsburgh, Pa.

Uhar, John J.,
Auditor,
Penn Iron & Steel Co.,
Creighton, Pa.

Unger, Dr. J. S.,
Manager, Central Research,
Bureau, Carnegie Steel Co.,
1054 Frick Bldg. Annex,
Pittsburgh, Pa.

Van Blarcom, Warren C.,
Supt., Aliquippa &
Southern R. R.,
Aliquippa, Pa.

Van Horn, I. L.,
Sales Rep.,
Ferbert-Schorndorfer Co.,
2426 Dover Center Rd.,
Dover Center, Ohio

Van Vranken, S. E.,
Secretary-Treasurer,
Pgh. Cleanser Laboratory,
261 N. Balph Ave.,
Bellevue, Pa.

Van Wormer, George M.,
Foreman, Erection Dept.,
Pressed Steel Car Co.,
129 Clairhaven St.,
Crafton Heights,
Pittsburgh, Pa.

Vollmer, Karl L.,
Asst. Steam Engineer,
Spang-Chalfant Co.,
106 W. Undercliff St.,
Etna, Pa.

Waldron, F. G.,
Die, Jig & Fixture Man,
Pressed Steel Car Co.,
62 Highland Ave.,
McKees Rocks, Pa.

Walker, Mrs. A. Fenton,
United States & British
Representative,
Canadian Railways &
Marine World,
Toronto, Can.,
140 Liberty St.
New York, N. Y.

Wallace, W. E.,
Section Foreman,
P. & L. E. R. R.,
452 Motheral Ave.,
Monessen, Pa

Walther, G. C.,
Foreman,
Penna. Railroad,
877 Second St.,
Verona, Pa.

Warfel, J. A.,
Dist. Manager,
Air Reduction Sales Co.,
1116 Ridge Ave.,
N. S., Pittsburgh, Pa.

Wark, J. M.,
Asst. Gen. Foreman,
Passenger Car Insp.
Pennsylvania Railroad,
7418 Penfield Court,
Pittsburgh, Pa.

Warner, E. O.,
District Sales Manager,
National Malleable &
Steel Castings Co.,
Insurance Co. of N.
America Bldg.,
Philadelphia, Pa.

Warner, Russell H.,
Asst. Train Master,
Aliquippa & Southern
R. R.,
2525 West Liberty Ave.,
Dormont,
Pittsburgh, Pa.

Warren, A. T.,
P. O. Box 120,
Michigan City, Indiana.

Waterman, Edwin H.,
Car Foreman, Union R. R.,
Monongahela Jct. Shop,
East Pittsburgh, Pa.

Watkins, T. A.,
Insurance Inspector,
Pgh Coal Co.—Montour
Railroad,
3835 Hiawatha St.,
N. S., Pittsburgh, Pa.

Watson, John,
Foreman,
Hanlon Gregory Galvanizing
Company,
5515 Butler St.,
Pittsburgh, Pa.

Watt, Herbert J.,
Mgr. of Sales Ry. Materials,
Jones & Laughlin Steel
Corporation,
Third and Ross Sts.,
Pittsburgh, Pa.

Weaver, J. E.,
Car Dispatcher,
Gulf Refining Co.,
Gulf Building,
Pittsburgh, Pa.

Weaver, W. Frank,
Storekeeper,
The Pullman Co.,
7506 Formosa Way,
Pittsburgh, Pa.

Webster, H. D.,
392 S. Main St.,
Greenville, Pa.

Weiler, Paul,
District Manager,
Franklin Railway Supply Co., Inc.,
68 W. Fourth St.,
Dunkirk, N. Y.

Welch, E. M.,
Service Engineer,
Dearborn Chemical Co.,
2615 Mackinaw Ave.,
Pittsburgh, Pa.

Wendt, Edwin F.,
Consulting Engr.,
Union Trust Bldg.,
Washington, D. C.

West, W. C.,
Railroad Division,
Standard Oil Co. of Pa.,
Public Ledger Bldg.,
Philadelphia, Pa.

West, Geo. S.,
Superintendent,
Monongahela Div.,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Whalen, Daniel J.,
Asst. Supt., Tank Dept.,
Pressed Steel Car Co.,
323 Broad Ave.,
Canton, Ohio

Wheatley, Wm.,
Inspector,
Ft. Pitt Malleable Iron Co.,
1113 Dohrman St.,
McKees Rocks, Pa.

Wheeler, Charles M.,
Sales Engineer,
Union Switch & Signal Co.,
Swissvale, Pa.

Whipple, A. L.,
District Sales Manager,
Standard Stoker Co., Inc.,
350 Madison Ave.,
New York City

White, A. B.,
Punxsutawney, Pa.

White, Charles G.,
Supervisor,
Aliquippa & Southern R. R.,
193 Clay St.,
Rochester, Pa.

White, Herbert A.,
Sales Mgr., Pgh. Dist.,
National Bearing Metals Corp.,
928 Shore Ave.,
N. S., Pittsburgh, Pa.

White, J. C.,
Superintendent,
Eastern Division,
Pennsylvania Railroad,
241 Dickson Ave.,
Ben Avon, Pa.

Whitmore, John G.,
Division Counsel,
B. & O. R. R. Co.,
Ridgway, Pa.

Whitridge, J. C.,
President & General Mgr.,
The Buckeye Steel Castings Company,
Columbus, Ohio

Wholey, V. A.,
Gen. Traffic Mgr.
P. & W. Va. Ry.,
Wabash Bldg.,
Pittsburgh, Pa.

Wiggins, W. D.,
Chief Engineer,
Pennsylvania Railroad,
1135 Penna. Station,
Pittsburgh, Pa.

Wikander, Oscar R.,
Mechanical Engineer,
Ring Spring Dept.,
Edgewater Steel Co.,
900 South Negley Ave.,
Pittsburgh, Pa.

Wilcox, H. C.,
Editorial Representative,
Railway Age,
643 Terminal Tower Bldg.,
Cleveland, Ohio

Wildin, G. W.,
Consulting Engineer,
Westinghouse Air Brake Company,
Westinghouse Bldg.,
Pittsburgh, Pa.

Wilharm, John H.,
Traffic Manager,
Diamond Alkali Co.,
436 Seventh Ave.,
Pittsburgh, Pa.

Wilkinson, F. C.,
Superintendent,
Penna. Railroad,
505 Rockavon Road,
Narberth,
Montgomery County, Pa.

Williamson, A. G.,
Union Switch & Signal Co.,
721 Washington Ave.,
Carnegie, Pa.

Wilson, James M.,
Metal & Thermit Corp'n.,
2961 Stafford St.,
Corliss Station,
Pittsburgh, Pa.

Winslow, Geo. S.,
Manager,
Ingersoll-Rand Co.,
Chamber of Commerce Building,
Pittsburgh, Pa.

Winslow, Sidney H.,
Service Engineer,
Franklin Rwy. Supply Co.,
1105 Biltmore Ave.,
S. H. B., Pittsburgh, Pa.

Witherspoon, B. H.,
President,
Pittsburgh Testing Laboratory,
Locust & Stevenson Sts.,
Pittsburgh, Pa.

Withrow, R. C.,
Division Sales Manager,
Freedom Oil Works Co.,
Brighton Heights,
New Brighton, Pa.

Wittman, Edward A.,
Loco. Boiler Inspector,
Montour Railroad,
606½ Mansfield Ave.,
West End, Pittsburgh, Pa.

Wood, E. H.,
Salesman,
Grip Nut Co.,
6136 Greenwood Ave.,
Jackson Park Station,
Chicago, Ill.

Wood, John H.,
Telegraph Operator,
P. & L. E. R. R.,
1404 Monterey St.,
N. S., Pittsburgh, Pa.

Woods, Joseph,
Statistician,
P. & L. E. R. R.,
5124 Baum Blvd.,
Pittsburgh, Pa

Woodward, Robert,
Machinist, P. R. R. System,
314 George St.,
Turtle Creek, Pa.

Woollen, A. H.,
Engineer,
Development Division,
Aluminum Company of America,
New Kensington, Pa.

Wright, C. W.,
Vice President,
Standard Steel Car Corp'n.,
Gulf Bldg.,
Pittsburgh, Pa.

Wright, E. W.,
Asst. to President,
Ft. Pitt Malleable Iron Co.,
5442 Baywood Ave.,
Pittsburgh, Pa.

Wright, John B.,
Assistant Vice President,
W. A. B. Co.,
Wilmerding, Pa.

Wright, O. L.,
421 Chestnut St.,
Philadelphia, Pa.

Wright, R. V.,
Managing Editor,
Railway Age,
30 Church St.,
New York, N. Y.

Wurts, T. C.,
Heavy Traction Section Head,
Westinghouse Elec. &
Mfg. Co.,
East Pittsburgh, Pa.

Wyke, J. W.,
Traveling Engineer,
Union Railroad,
East Pittsburgh, Pa.

Wynne, F. E.,
Asst. Gen'l. Manager,
Ry. Engr'g. Dept.,
Westinghouse Elec.
& Mfg. Co.,
East Pittsburgh, Pa.

Yarnall, Jesse,
Asst. Yard Master,
Pennsylvania Railroad,
123 Race St.,
Edgewood, Pa.

Yeakel, J. C.,
Asst. Engineer,
Montour R. R. Co.,
Apt. 3, Albert Apts.,
Coraopolis, Pa.

Yohe, C. M.,
Vice President,
P. & L. E. R. R.,
Pittsburgh, Pa.

Yohe, J. B.,
Retired—Vice President,
P. & L. E. R. R. Co.,
106 P. & L. E. Term.,
Pittsburgh, Pa.

Young, F. C.,
Rep. Westinghouse Air
Brake Co.,
207 Westinghouse Bldg.,
Pittsburgh, Pa.

Zammikiel, John
Clerk,
Union Railroad Co.,
413 Boyd St.,
Turtle Creek, Pa.

Zilian, Ralph F.,
Engine House Foreman,
Penna. Railroad,
3610 Wickshire St.,
Pittsburgh (12), Pa.

Zirckel, Arthur H.,
Asst. Traffic Manager,
Pittsburgh Steel Co.,
700 Union Trust Bldg.,
Pittsburgh, Pa.

Zitzman, N. E.,
Chief Clerk,
P. & L. E. R.,
616 P. & L. E. Annex
Bldg.,
Pittsburgh, Pa.

Zollars, W. L.,
Freight & Ticket Agent,
P. & L. E. R. R.,
326 South Eighth St.,
Connellsville, Pa.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of Official Proceedings—Railway Club of Pittsburgh, published Monthly, except June, July and August, at Pittsburgh, Pa., for October 1, 1932.

STATE OF PENNSYLVANIA } ss:
COUNTY OF ALLEGHENY }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared J. D. Conway, Secretary, who having been duly sworn according to law, deposes and says that he is the Editor and Publisher, of the Official Proceedings—Railway Club of Pittsburgh.

Publisher Official Proceedings—Railway Club of Pittsburgh.

Editor, J. D. Conway, 515 Grandview Avenue, Pittsburgh, Pa., (19th Ward.)

Managing Editor, J. D. Conway, 515 Grandview Avenue, Pittsburgh, Pa., (19th Ward.)

Business Manager, J. D. Conway, 515 Grandview Avenue, Pittsburgh, Pa., (19th Ward.)

The Official Proceedings—The Railway Club of Pittsburgh.

President, J. E. Hughes, Pittsburgh, Pa.

Vice President, F. I. Snyder, Pittsburgh, Pa.

Secretary, J. D. Conway, Pittsburgh, Pa.

Treasurer, E. J. Searles, Pittsburgh, Pa.

Known Bondholders—None.

J. D. CONWAY.

Sworn to and subscribed before me this 26th day of September, 1932.

(Seal) AGNES B. SHAW, Notary Public.
(My commission expires March 9, 1935.)

RESERVED

OFFICIAL PROCEEDINGS
RAILWAY CLUB OF PITTSBURGH
$1.00 Per Year 25¢ Per Copy

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MODERN RAILWAY SIGNALING

By A. H. RUDD, Chief Signal Engineer,
Pennsylvania Railroad, Philadelphia, Pa.

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OF

The Railway Club of Pittsburgh

Organized October 18, 1901

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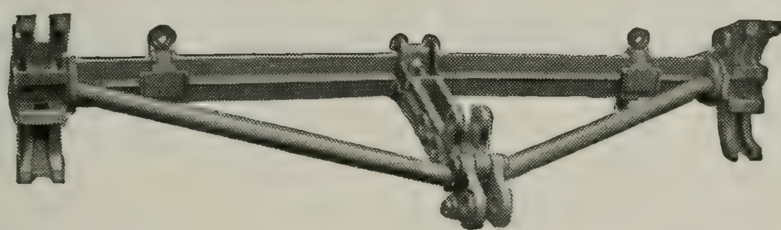

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OFFICIAL PROCEEDINGS
OF
The Railway Club of Pittsburgh
Organized October 18, 1901

Vol. XXXII No. 1 — Pittsburgh, Pa., Nov. 17, 1932 — $100 Per Year, 25c Per Copy

Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING

November 17th, 1932.

The meeting was called to order at the Fort Pitt Hotel at 8 o'clock, P. M. with President F. I. Synder in the chair.

Attendance, as shown by registration cards handed in, 172, as follows:

MEMBERS

Allen, Harvey
Anderson, Burt T.
Babcock, F. H.
Balzer, C. E.
Beam, E. J.
Best, D. A.
Blackmore, G. A.
Carlson, L. E.
Carr. T. W.
Carson, John
Christy, F. X.
Connors, John M.
Conway, J. D.
Coulter, A. F.
Dambach, C. O.
Davies, James
Diven, J. B.
Downes, D. F.
Eagan, D. F.
Emery, E.
Emsheimer, Louis
En Dean, J. F.
Endsley, Louis E., Prof.
Evans, Robert E.
Ferguson, R. G.
Flinn, R. H.
Forsberg, R. P.
Fox, George W.
Gilg, Henry F.
Goda, P. H.
Gorman, Charles
Grove C. G.
Guinnip, M. S.
Hall, Chester C.
Hansen, William C.
Henry, C. J.
Hill, Harold A.
Holmes, E. H.
Honsberger, G. W.
Howard, L. F.
Huff, A. B.
Hughes, John E.
Hykes, W. H.
Irwin, R. D.
Jones, H. W.
Kellenberger, K. E.
Keller, R. E.
King, C. F.
Kirsch, O. W.
Kramer, W. E.
Kraus, Raymond E.
Kromer, William F.
Kummer, Joseph H.
Lanahan, J. S.
Laughner, C. L.
Laurent, Joseph A.
Layng, F. R.
Lee, L. A.
Leet, C. S.
Lundeen, Carl J.
Manning, J. F. Jr.
Masterman, T. W.
Millar, C. W.
Miller, R. C.
Misner, G. W.
Mitchell, F. K.
Mitchell, W. S.
Molyneaux, D. S.
Montague, C. F.
Myers, B. E.
McHugh, C. A.
McIntyre, R. C.
McKenzie, Edward F.
McKinstry, C. H.
Newell, J. P., Jr.
Painter, Joseph
Paisley, F. R.
Pickard, S. B.
Posteraro, S. F.
Raymer, I. S.

Robinson, J. M.
Robinson, R. L.
Rudd, W. B.
Schmitt, Raymond F.
Schrader, A. P.
Seiss, W. C.
Sekera, Charles J.
Sharp, H. W.
Sinclair, I. B.
Sixsmith, G. M.
Smith, J. Frank
Snyder, F. I.
Stevens, R. R.
Stucki, A.
Sullivan, P. W.
Thomas, T.
Tomasic, N. M., Jr.
Trax, Louis R.
Tucker, J. L.
Van Blarcom, W. C.
Van Wormer, G. M.
Wark, James M.
Weaver, W. Frank
Wheeler, C. M.
Wildin, G. W.
Williamson, A. G.
Wright, Edward W.
Wright, John B.
Wyke, J. W.
Yarnall, Jesse
Young, F. C.

VISITORS

Balla, J. A.
Bartley, J. E.
Baughman, G. W.
Bruner, H. L.
Cadwallader, W. H.
Cameron, M. B.
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Crawford, A. M.
Crossen, W. R.
Day, T. R.
Dean, W. A.
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Dunn, J. H.
Fike, J. W.
Flinn, Frank T.
Froelich, F. A.
Gray, R. E.
Hamilton, Russell F.
Harman, H. H.
Harwig, C. G.
Hawkes, T. L.
Hibbs, C. E.
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Kerchner, J. H.
Knopf, John A.
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Logan, J. W., Jr.
Loomis, H. S.
Lundeen, R. G.
Masters, Charles
Miller, George
Moses, Archie
McCormick, E. S.
McCrossin, C. D.
McFetridge, W. S.
McGaughey, J. V.
Nicholson, F. H.
Overholt, B. C.
Pry, E. B.
Reed, Fred W.
Reitlich, B. H.
Robinson, A. R., Jr.
Rorabaugh, C. F.
Roughley, R. F.
Rudd, A. H.
Ryan, J. C.
Smith, Sion B.
Snodgrass, T. R.
Stewart, W. D.
Stratford, C. T.
Sutton, R. C.
Thompson, H. A.
Tripp, W. C.
Van Nort, A. V.
Wallace, H. A.
Wiland, O. M.

The call of the roll was dispensed with, as a complete record of attendance is shown on the registration cards.

By common consent the reading of the minutes of the last meeting was dispensed with, as the Proceedings have been printed and distributed to the members.

The Secretary read the following list of applications for membership:

Church, S. L., Engineer, Maintenance of Way, Pennsylvania Railroad, 220 Pennsylvania Station, Pittsburgh, Pa. Recommended by R. H. Flinn.

Ferguson, James H., Jr., Draftsman, Union Railroad Company, 1435 Foliage Street, Wilkinsburg, Pa. Recommended by A. F. Coulter.

Harman, H. H., Engineer Track, B. & L. E. R. R., Greenville, Pa. Recommended by F. I. Snyder.

Henry, C. J., Supervisor of Track, Pennsylvania Railroad, Trafford, Pa. Recommended by C. G. Grove.

Kramer, William E., Representative, Acme Steel Company, 3684 Middletown Road, Corliss Station, Pittsburgh, Pa. Recommended by E. A. Rauschart.

Moss, Gilbert, Sales Engineer, Key Boiler Equipment Company, 1114 East Street, Wilkinsburg, Pa. Recommended by E. A. Rauschart.

McFetridge, W. S., Principal Assistant Engineer, B. & L. E. R. R., Greenville, Pa. Recommended by F. I. Snyder.

Reuter, Paul C., Draftsman, Union Railroad Co., 20 Franklin Street, North Irwin, Pa. Recommended by A. F. Coulter.

Ryan, James H., Manager, Tank Car Department, Gulf Refining Company, 2030 Gulf Building, Pittsburgh, Pa. Recommended by G. W. Wildin.

Sullivan, J. C., Superintendent, Tank Car Department, Gulf Refining Company, 2033 Gulf Building, Pittsburgh, Pa. Recommended by G. W. Wildin.

West, Troy, Draftsman, Union Railroad Company, 309 East 9th Street, Homestead, Pa. Recommended by A. F. Coulter.

PRESIDENT: It is gratifying to have so large a list of applications for membership under present conditions. In ac-

cordance with our By-Laws these applications will be referred to the Excutive Committee, and upon approval by that Commitee the applicants will become members without further action of the Club.

Is there any other business that should come before the Club at this time? If not, we will proceed with the paper of the evening, which is on a very interesting subject, Modern Railway Signaling. We have to present the paper one very well known in the signal activities of the railroads. Whenever signaling is mentioned I think we all associate with it the name of Mr. A. H. Rudd. Mr. Rudd has been in this line of activity in railroad work for many years. He is not a stranger here as he has appeared before this Club at least twice before although I think not in recent years.

There has been a considerable advance in the art of signaling since he appeared before our Club last and we are fortunate in having him here tonight to present some of the modern developments. He is Chief Signal Engineer of the Pennsylvania Railroad and we are very glad to welcome and again hear from Mr. A. H. Rudd.

MODERN RAILWAY SIGNALING

By A. H. RUDD, Chief Signal Engineer, Pennsylvania Railroad, Philadelphia, Pa.

After your Chairman of the Subject Committee told me he wanted me to address you collectively this evening, remembering that I had spoken here before, I looked through the files to refresh my failing memory and found that my first appearance here was May 23, 1913, my second April 29, 1921, and my third —and out—tonight!

In order to avoid vain repetition, I looked over my former remarks and then decided that a repetition in full of what I said when young and virile might yield greater enjoyment than anything I might say as I grow old and senile.

This life, however, is a series of compromising or being compromised. I've had a wide experience in both phases. Therefore, it seemed that I might gather up the loose ends 50-50, especially as some of the statements I made in 1921 are so applicable to conditions of today. I'll quote in part:

"Just at present we are making about as rapid progress as a crab and in the same direction—sideways—and, if they don't stop closing interlocking and block stations, I'll soon be like the

lame officer—going to charge and probably then retreat and, being lame, I'll start now! For you see I've got to keep ahead of the gang and try to lead it—somewhere.

"The old railroad craft is rolling badly, the wind is squally and the signalman is hanging over the rail (or possibly over the ropes) with his teeth clenched, trying to keep from losing what he's got, for the commotion surely makes him sick.

Lately also we've heard that the boat is leaking. Of course, we should not care (Jew, the boat is sinking). Some say these leaks are caused by the Management through interlocking directorates. As soon as I heard of interlocking directorates, I was immediately interested and have given the matter much study."

I then proceeded to analyze the way in which the interlocked railroad, bank, manufactory and supply firm directors enriched themselves by destroying their own profits.

"Ive tried to find a solution, and, as I see it, the best way is for the railroads to carry freight and passengers for nothing, so everybody can ship stuff and travel; then hire a million of the men who are now unemployed to work on improvements at increased wages and, as time is money, have them work only one hour a day, so everybody will be busy, and pay them for 24 hours a day, straight time, so everybody on the railroad will have plenty of money. The employes will spend their money for goods and that will make a market for all the shippers, and they can sell cheap because they have no freight to pay.

"I've got it all worked out except one little point—where will the railroads get the money to pay the men—and I'm working on that now. I think eventually we shall get it from the Government, and the Government will get it by levying a universal income tax on everybody of 100%.

"I have approached this problem unprejudiced, because I am neither a director and a capitalist on the one side nor a working man—so-called—on the other. I'm like the old fisherman—I just sit and think or just sit. I told a fellow once I don't get paid so much for the work I do as for what I know, and he said: 'Well, whatever your salary is, you're damned badly overpaid'."

All I can say of my own knowledge is we're all in a hell of a fix, and so we'll get down to Modern Signaling.

It is a strange coincidence that you only ask me to speak here during depressions and in times of adversity. When times are good you get someone else.

In 1913 I talked to you about semaphore signals and the

colored lights that go with them. I told you that on the Pennsylvania Railroad the old home and distant signal would disappear and three-position upper-quadrant signals take its place, and that in time we should have green for clear and yellow for caution—those prophecies were all realized by 1921, and, with the exception of our Pittsburgh Yard, three-position signals were in use on our main lines from New York to Chicago, Pittsburgh to St. Louis, and Philadelphia to Washington, and all East of Pittsburgh and many West were upper-quadrant, while green for clear was in service over the entire System.

I also stated in 1913: "This system as it stands will, I believe, remain unchanged on the Pennsylvania Railroad for a considerable time"—and two years later we began to change it.

In describing the signal system of 1921 and the advantages of the various pieces of apparatus, I included position-light signals, which were then a comparatively new development. The first were installed in 1915. January 1, 1932, we had 8,632 high position-light signals and 3,596 dwarf signals in service, or about 60 per cent of all our signals.

In 1921 I said: "We still need: Simplify operation by non-stop at automatics on double or more tracks:" As to changing the stop and proceed signals on double or more tracks to permit certain trains to pass without stopping: I am still advocating this, as I did eleven years ago, and we have got some results, in that we have what is known as the Grade Signal, indicated by a black "G" on a yellow background, which tonnage freight trains are permitted to pass without stopping, such train being defined as having 80% or more of the authorized slow freight engine rating, or, having in excess of 90 cars, including the cabin car. We are now advocating permitting all trains equipped with cab signals in operative condition to pass stop and proceed signals without stopping at a speed of not exceeding 15 miles per hour, but requiring those not equipped or on which the apparatus is inoperative to stop at such signals. We may yet arrive!

On the engineering end, while we have not attained the A.C. storage battery I suggested, we have gone through several stages in rectifiers, starting with one which was a vibrator and changed A.C. to D.C. by eliminating every alternate alternation of the current; then to one without moving parts, which looked something like a primary battery of the soda type, known as the Balkite, and finally have adopted the copper-oxide rectifier which is very reliable and requires practically no maintenance, and

enables us to use commercial A.C. power for operating our signal lights with the battery as a standby service, these lights being interchangeably operative with A.C. or D.C.

A two-position relay without moving parts has been invented, but has not come into general use. It needs to be further improved.

In 1921 I listed other problems still to be met:

First—Location of advance signals at interlockings: We are taking care of that by eliminating them.

Second—Elimination of derails on two or more track roads: Pennsylvania Railroad rules are that derails shall be used in main tracks only where required by Federal or State authorities, or where authorized by the General Manager. The Signal Section of the American Railway Association is on record as opposing them in main tracks, the Signal Section Manual stating: "Derails should not be used in main tracks. On heavy grades where the need of some device to check runaway trains or cars is indicated, properly designed deflecting tracks may be used." The Public Service Commissions in a few States do not require them, while in others they are still insisted on.

Third—Automatic Stops and Need for Continuous Track Circuit Controlled Speed Control: We now have both, and within the past five or six years tremendous developments in new devices have been made chiefly by the two great signal companies, the General Railway Signal Company of Rochester, N. Y., and your own Union Switch, which I believe, responsible for more advancement in the art of safe, expeditious and economic operation of railroad trains than any other single agency. Because it is located on our line and for other good and sufficient reasons the Pennsylvania Railroad has been its goat and, after the development in the laboratory of any particular device, it is recommended to us for trial and we pick flaws in it (one of the easiest jobs we have) and perfect it. This may sound queer, but I'm going to take two or three minutes to give you a little history as an advertisement of the Pennsylvania Railroad.

Out of about 52 or 53 outstanding developments since signals were first used in this country, 38 or 73% were first tried out and developed on the Pennsylvania Railroad and lines which are now included in the System. There may have been a few more but those mentioned are enough to show that we have not been, as it were, asleep at the switch.

LIST OF DEVICES USED BY PENNSYLVANIA RAILROAD BEFORE ANY OTHER RAILROAD IN AMERICA:

Fixed signals for handling trains, Newcastle & Frenchtown, 1832.
First manual block, 1863-4.
First smashboards at drawbridges, 1868.
First mechanical interlocking, 1870.
Second mechanical interlocking, 1875.
First normally open track circuit, 1870.
First normally closed track circuit, 1872.
First power-operated interlocking, 1876.
First automatic train stop (tube), 1880.
First electric switch lock, 1885-1900.
First position signal, day and night, Koyle, 1887-8.
First electric interlocking, crossing with B. & O. S. W., 1890.
First semi-automatic terminal signals, 1891.
First pushbutton switch machine, 1892-3.
First D.C. motor signals with motor and mechanism in same case, 1897.
First three-block indication signals, 1900.
First track circuit locking, 1900.
First remote controlled switch, 1901.
First approach locking with automatic release, 1905.
First one-arm three-position upper-quadrant signal, 1906.
First electro-mechanical machine, 1906.
First controlled manual block system with continuous track circuits, 1907.
First Smith lift rail lock, 1907.
First Weaver lift rail lock, 1907.
First large terminal all signals automatic and second through route locking, 1908.
First electro-mechanical machine, present type, 1909.
First color light signals for outdoor day use, 1910.
First automatic trip stop with three-finger ends, 1910.
First three-block indication with three-position upper-quadrant signals, 1911.
First A.C. motor signals, induction holding device, 1912.
First position light signals, 1915 .
First three-speed continuous train control with three-indication cab signals, 1923.
First three-indication cab signal with whistle and acknowledger, 1926.

First four-indication cab signal coder system stop and forestaller, 1927.

First combined switch lock and signal control mechanism, 1928.

First continuous four-indication cab signal with whistle and acknowledger, coder system, 1929.

First mechanical locking for spring switch withdrawn by car, September 27, 1932.

Now installing first coder system for operating wayside as well as cab signals; will be in service this winter.

In addition, in 1922 developed the alternate flashing light highway crossing signal for Signal Section, although not the first to install.

While there have been almost innumerable developments in signaling since I spoke here in 1921, there have been, in my opinion, twelve which are outstanding—some on account of increased safety, some on account of greater facility of train operation with resulting economy, others just producing savings alone, and some combining all three. They are as follows:

Highway Crossing Signal: (SLIDE C-30828—SLIDES showing two graphs of accidents at highway crossings in the State of Pennsylvania—illustrate with model).

The development of this started in 1922, when the Signal Section of the A. R. A. recommended that:

"A mechanically or electrically operated signal used for the protection of highway traffic at a grade crossing shall present toward the highway when indicating the approach of a train the appearance of a horizontally swinging red light and/or disc."

(Outline development from the beginning to the recommended practice of the A. R. A., and outline efforts to educate the people).

Automatic Stop—Speed Control: As stated a little while ago, the first automatic train stop in the United States was installed on the Pennsylvania Railroad in 1880 (DESCRIBE). IN 1900 electro-pneumatic trippers were installed on the Boston Elevated, an arm was raised alongside the track and turned an angle cock on the train, giving an emergency application of the air. Similar devices were installed on a number of suburban electric lines, and in 1910 in the Pennsylvaina Tunnels, with additional equipment to prevent their operating the train brakes if encountering obstacles outside the tunnels. (DESCRIBE).

A number of experiments were made in a desultory fashion

of various induction devices and a ramp device was installed on the Rock Island about 1920.

However, developments were slow until the Interstate Commerce Commission in its order No. 13413 of June 13, 1922, ordered fifty railroads to install an automatic stop device without any forestalling devices, or speed control, commonly called train control. From that time on, the development was rapid. A number of railroads installed intermittent induction devices located at the wayside signals while others installed devices of the continuous operating type, one of these being the Pennsylvania Railroad, and I shall confine my remarks to this system, because it has been shown to have the greatest possibilities and, in my opinion, the extra expense is entirely justified. (DESCRIBE: Lewistown Branch installation, with cab signals as a by-product; Baltimore Division installation, with stop and forestaller, then the code system).

Train Operation by Signal Indication: The old method was by the use of train rules, train orders, and the timetable, trains being given superiority by direction, by class, or by right, no block system being used, and a considerable mileage of the country is so operated today. Later, on many railroads manual block was superimposed, the practice on the P. R. R. being absolute block for opposing movements, absolute block to protect passenger trains, with permissive block for following movements of freight trains. This was followed by the introduction of automatic signals operated by the train itself.

For many years it has been the practice of the Pennsylvania R. R. on two or more tracks equipped with interlockings and automatic signals to run trains entirely on signal indication for movements in the direction of traffic, but to issue train orders and establish manual block for movements against the current of traffic. Later, the controlled manual block system was invented for single track operation, using continuous track circuits, to check the signalmen, with or without automatic signals for following movements only; this, of course, required operators at each end of any given section, and the expense was large. Later what is known as the "APB" (Absolute Permissive Block) system of automatic signals on single track came into extended use; with this arrangement, stop signals were located at the exit ends of sidings, and known as absolute signals, and stop and proceed signals in between, known as permissive signals. Trains receiving a stop signal were required to remain

until they had called up and received permission under the rules to proceed; as soon as train passed such stop signal it set the opposing absolute signals to stop and the intervening conflicting signals to stop and proceed. This system did away with the necessity for superiority by direction or class, but still required the use of train orders.

Dispatchers Remote Control: Was the next development. When we installed the automatic stops on the Lewistown Branch, we applied this "APB" system to one-half the line, and the Dispatchers Remote Control system to the other. In this latter system, the dispatcher established the direction of traffic, which was retained as long as the train occupied the section between signals, so that no opposing train obeying the signals could enter. Meanwhile, methods had been devised for successfully and safely operating switches located at long distances from the point of operation, known as remote control, the proper term being remote operation.

Centralized Traffic Control: Finally by a combination of these three systems, after several years of experimentation and a tremendous amount of development work, a system known as Centralized Traffic Control was evolved, by the use of which trains are operated entirely by signal indication, superiority by direction, class, right, or timetable being dispensed with, and the use of train orders made unnecessary, except, of course, when there is a complete breakdown of the system. The dispatchers or other designated employes, in coordination with the trains themselves, control the switches and associated signals in the C.T.C. territory, which may be as long as an entire operating division. This system is applicable to single or multiple track lines, may be superimposed on an existing signal system, and has been found to increase the economical capacity of single track, to increase the flexibility of operation and to decrease the road time of trains. While the traffic on many divisions does not justify its universal use, it is meeting with increased favor. (SLIDE C-29229—Machine at Limedale on the P. R. R., which controls the section of track between Alameda and Ben Davis. SLIDE C-28793—A freight operating in this territory. SLIDE C-29906—"The American" crossing over).

One of the recent installations is on the B. & O. R. R. between North Lima and Roachton. This installation includes 35 switches and 129 signals, controlled from the C.T.C. machine at Deshler. (SLIDE C-30157)—It includes 56 miles of single

track with 13 passing sidings and is of such extent that the machine had to be turned up at the sides so as to bring the levers within reach of the single operator.

Approach Lighting: Another development is the wholesale use of approach lighting in the interest of economy. In the old days this was done on single track to some extent. Recently it has been extended to three and four tracks, four-track installations being extensively used on the New York Central, on P. R. R. S. W. Junction to Latrobe, Sang Hollow Ex tension, Gallitzin to Altoona and on double and three-track lines. A train approaching on any track not only lights its own signal, but the signals governing in the same direction on other tracks, as a means of having the engineman identify his own signals. Approach lighting reduces current consumption to a minimum, as the lamps are only lighted a short portion of the twenty-four hours.

Automatic Interlockings: The principle of the "APB" system, by which a train establishes its own traffic direction ahead has, within recent years, been applied to interlockings, especially at grade crossings, so that, if two trains are approaching the crossing, the one to first reach the approach section clears its signals ahead and holds the signals at stop on the other road. While primarily introduced at grade crossings, its use has been extended to interlockings where several switches may be involved. Where one road has a number of fast and important trains and the other a few unimportant, its use is not recommended as there is too much chance of a slow drag freight interfering with the movement of a high speed passenger train, and no means has yet been devised for differentiating between these two animate objects in giving preference.

Car Retarders: (Take Bulletin describing advantages): These devices have already been described to you, but you may be interested in one view of those installed at Pitcairn two or three years ago—(SLIDE 27522) which shows two of the operating cabins with retarders and one signal. (SLIDE C-27526)—This is another view of the Pitcairn layout. Your attention is particularly directed to the switch signal, which is another development of recent years. Instead of the revolving switch lamp and target, which is hardly ever in absolutely correct adjustment and focus, a case with two electric lights is shown, one green and the other yellow or red as required, which

are operated through a circuit closer on the switch, and reduce maintenance.

T-10 Mechanism for Hand-Operated Switches: In 1928 Mr. Charles C. Thorn, one of the P. R. R. engineers, invented a combination mechanism for hand-operated switches, which operates the switch, locks it, and embodies a point detector which insures that the points have closed, and is of particular value if the switch has been run through and remained locked, and also provides circuit closers for the operation of protecting signals. The use of these has increased very fast. (SLIDE C-29054).

Light Signals: You have been told about the development of position-light signals and if you ever see the Pennsylvania Railroad in the neighborhood of Pittsburgh you will doubtless have watched their operation. About the same time that they were developed, the electric lights used in semaphores were greatly improved in volume and range and consequent visibility, and a great number of the railroads are now using colored lights for day and night indications. Mr. F. P. Patenall, formerly Signal Engineer of the B. & O. R. R., and whose death a few years ago was a great loss to the profession, invented a third scheme called the color-position-light signal. (SLIDE C-30117). This system is radically different from either the position-light or the color-light, and has the advantage of considerable economy, but has not met with universal favor on account of the differences in principles involved. (EXPLAIN). If we were to start our signaling all over, I have no doubt this system would be highly favored by a large number of the railroads.

Spring Switches: For years it has been realized that if spring switches could be made safe for facing movements, their use would be greatly extended, especially at the exit ends of passing sidings and the ends of double track; without them and without remote control or an attendant, the crews of trains leaving passing sidings are required to throw the switch to let the train out and some member of the crew must remain to close it again after the train has passed. The chances of some obstruction preventing the switch from properly facing up after train has left has deterred many roads from using these economical and labor saving devices. However, within the last few months, the Union Switch & Signal Co. has developed an ingenious lock for such switches, which, in my opinion, makes such switch as safe as any other locked switch and removes the

necessity for restricting speed when running over it facing. (SLIDE C-30838). First installed at Duff Junction, Panhandle Division, Pennsylvania Railroad, September 27, 1932, as previously stated.

Shunting Device for Light Weight Cars: The problem of maintaining an adequate shunt on track circuits has been accentuated in recent years by the development of self-propelled cars of very light weight. The introduction of the rubber tired rail car made imperative a method of shunting which would not depend upon the weight of the car.

A method very recently developed to solve this problem is one of the most recent contributions of the Signal Company to the broader field of transportation. The new principle involved consists of providing a source of electrical power on the car which will break down the high resistance from the brush, or wheel, on the car to the rail, and by causing a current to pass, will keep the resistance down to a value sufficiently low to shunt the track relay.

Coder System for Wayside Signals: When the coder system of cab signals was developed, I suggested to our friends in Swissvale that this might also be extended to the operation of wayside signals by some modification of the apparatus. This was July 20, 1926. As usual, they had already thought of this, but for several years they were so busy in other developments that this scheme was pushed into the background. When business became slightly slowed down two or three years ago and their engineering department had more time to devote to development, they took up this work and we are now installing a section in West Philadelphia which we hope to have in operation this winter.

This section is about 2½ miles of double track, with five blocks in each direction, running from "Zoo" interlocking, then under the new Thirtieth Street Station, to "Arsenal" interlocking, located near the Commercial Museum in West Philadelphia.

At the time I wrote them, six years ago, I stated that, as I saw it, some of the advantages were as follows:

In Train Control or Cab Signal Territory

First—Simplifying the circuits through interlockings. As far as we have gone, the scheme does not accomplish this at large interlockings, such as at terminals, but it is applicable without undue complication at smaller plants.

Second—Giving foreign current protection for cab signals in approach block as well as in occupied block.

Third—Same track circuit control for wayside signals as for train control, so that, if wayside signals are installed with this system, no change will be needed for operating train control except equipping the engines. Of course, engines already equipped would operate over such circuits.

Fourth—Elimination of flips in train control or wayside signals.

Fifth—Thereby making unnecessary the use of slow acting pneumatic relays for whistle and acknowledger or for stop and forestaller.

Sixth—Thus simplifying the engine equipment.

Of course, such changes could not be made on our engines now, because all of our signals so far are operated by steady current instead of by impulses, and the locomotives would be responsive thereto.

Whether Train Control is Installed or Not

Seventh—Same track circuit scheme for electrified territory as for steam territory.

Eighth—Elimination of A.C. track relays.

Ninth—Probable elimination of slow acting relays for wayside signal control.

Tenth—Elimination of a lot of line circuits in A.C. propulsion territory, and of all line circuits in much of the territory.

This elimination constitutes such a saving in cost of installation that additional installations will be justified.

A couple of years ago we installed a lot of automatic signals in territory where foreign current was present and, therefore, had to put protective relays at the exit end of the circuit, which constituted part of the control of the signals at the entrance end. Last year we had a very severe storm; all these wires were down and signals were out of service for several days. Had we installed the coder system, there would have been no control wires involved except some at highway crossings, and the two-wire power line could have been placed in cable and we would probably have had no interruption.

This system constitutes the best protection against foreign current of any device I have ever seen, and that in itself and the elimination of line wires justifies an installation of this kind even on lines of light traffic, if power is available.

PRESIDENT: Mr. Rudd has shown us that old things are sometimes new as well as a lot of new things tonight. We have an open forum in the Railway Club, and if any one has any questions Mr. Rudd I am sure will be glad to give further information, or perhaps you may have some remarks that you would like to present on your own account. There is now opportunity for discussion.

If I heard correctly Mr. Rudd made some mention of the Union Switch and Signal Company. I see Mr. Blackmore, President of that company, in the audience and we would be glad to hear from him.

MR. G. A. BLACKMORE: As usual, Mr. Rudd has presented the subject so thoroughly that when he is through there is nothing left for any one else to say. I do not know that I can add anything to what Mr. Rudd has said except to say that it is a pleasure to be here and to listen to him.

PRESIDENT: Has any one else anything to say? I have a lot of names here and I will call on you if you do not volunteer. Mr. J. H. Dunn, Railway Signaling.

MR. J. H. DUNN: I cannot add anything to the discussion presented by Mr. Rudd. I have very much enjoyed being here and I think it may be enough to say that I came all the way from Philadelphia to hear him, and I have been repaid for coming.

PRESIDENT: Mr. S. B. Higginbottom, Superintendent Telegraphs and Signals, Pennsylvania Railroad, may we hear from you?

MR. S. B. HIGGINBOTTOM: I am afraid you will have to correct that title. It is Supervisor of Telegraphs and Signals.

The last time I heard Mr. Rudd was when we met in the Americus Club down on Smithfield Street. I remember at that time he predicted three things, first, a signal with no moving parts; second, an A.C. storage battery; and third, a relay with no moving parts. We have them all.

PRESIDENT: Mr. E. B. Pry, Superintendent of Telegraphs and Signals, Pennsylvania Railroad, have you anything to add?

MR. E. B. PRY: Mr. Chairman, I am very glad indeed to be here tonight. I may say that I heartily endorse everything

Mr. Rudd has said. I have been connected with signaling for the last thirty years and have a fair knowledge of these various developments to which he has referred tonight and it has been a great pleasure to listen to his address.

PRESIDENT: Mr. R. F. Roughley, Supervisor of Telegraphs and Signals, Pennsylvania Railroad.

MR. R. F. ROUGHLEY: I have enjoyed being here tonight and hearing Mr. Rudd's talk. I do not think there is anything I can add to it.

PRESIDENT: Mr. W. A. Dean, Signal Supervisor, P. & L. E. R. R. Co.

MR. W. A. DEAN: I haven't anything to add to the discussion. I am glad to have had the privilege of being here and listening to what Mr. Rudd had to say.

PRESIDENT: Mr. L. F. Howard, Chief Engineer, Union Switch and Signal Company.

MR. L. F. HOWARD: Mr. Chairman, I have nothing to contribute to this discussion except a hope. Mr. Rudd referred to his talk in 1921 as a basis for reference in showing the improvements which have been made in the interim. In referring, however, to the part which the Union Switch and Signal Company has taken in this development, he used no such basis of reference, but told how the burden had devolved on the Pennsylvania Railroad of picking out the "bugs" in our developments. Now this leaves our reputation as developing engineers hanging in mid air, because it takes at least two points to determine the direction of a line and Mr. Rudd's statement gives no indication as to whether our trend is up or down. My hope is that when Mr. Rudd comes back to talk to us at the end of another eleven years he will refer to his statement regarding the burden which Union Switch and Signal Company developments was putting on his railroad in 1932, and then go on to say that so much improvement has been accomplished by the Union Switch and Signal Company in this respect that he has been able to eliminate all his delousing stations.

PRESIDENT: Mr. W. H. Cadwallader, Vice President, Union Switch and Signal Company.

MR. W. H. CADWALLADER: I do not know that I have anything especially to add, but when Mr. Rudd goes back over

these old developments he is talking about the days when I was still in the cradle. I have been employed in signal work for many years and that makes me wonder how old Mr. Rudd really is. I have been with the Signal Company since 1891 and a good many of the items mentioned tonight have been subjects with which we have lived during the development period. I have enjoyed the meeting very much and am very glad to have been with you.

PRESIDENT: I wonder if Mr. W. B. Rudd, General Engineer of the Union Switch and Signal Company, has anything to say.

MR. W. B. RUDD: There is just one point I would like to make. The other Mr. Rudd cited 1921 and read what he had said then as though that applied now, and of course you get the inference that what he said applies forever. Twenty years ago I was firing an engine and one of the engineers I was firing for said to me: "Why in the world don't some of these birds that work all these things out get a signal and put it in the cab instead of putting all these things outside on the rails." The next day I told this to my father and he said: "That would be a h—l of a thing." But he doesn't talk that way now.

MR. A. H. RUDD: "Out of the mouths of babes and sucklings proceedeth knowledge."

PRESIDENT: Has any one else anything to add? If not, we have reached the point of adjournment to the tables where a lunch awaits you, to which you are all invited. Before we adjourn I will ask Mr. Hughes, our just retired President, if he has anything to say.

MR. JOHN E. HUGHES: Mr. President and Gentlemen: I have had two treats tonight. The first one I had up in the dining room when the Secretary very kindly seated me at the table beside Mr. Rudd. I want to assure you that we did not talk about Modern Railway Signaling. The second treat was the manner in which Mr. Rudd has so comprehensively presented the subject here tonight.

Which reminds me of a story I heard one time about the colored fellow who was to be hung and his time was getting short. So the officer in charge of the festivities said to him, "Rufus, what have you to say?" "Well," said Rufus, "Mr.

Officer, this is certainly going to be some lesson to me." I think that remark applies to Mr. Rudd's address tonight, and I want to make a motion that this Club extend a vote of thanks to Mr. Rudd for the very wonderful address he has given us tonight.

The motion prevailed by a unanimous rising vote.

SECRETARY: Before we adjourn I wish to say that the music tonight has been rendered by Professor Richard Keener. The second number he played was of his own composition. He plays a great many pieces that he claims as his composition. He handles the keys very much as Mr. Rudd throws switches and brings up new lights and pleasures for our edification.

PRESIDENT: If there is no further business, the meeting stands adjourned.

J. D. CONWAY, Secretary.

RESERVED

OFFICIAL PROCEEDINGS
RAILWAY CLUB OF PITTSBURGH
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ELECTRONS AT WORK AND AT PLAY

By DR. PHILLIPS THOMAS, Research Engineer,
Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

OFFICIAL PROCEEDINGS

OF

The Railway Club of Pittsburgh

Organized October 18, 1901

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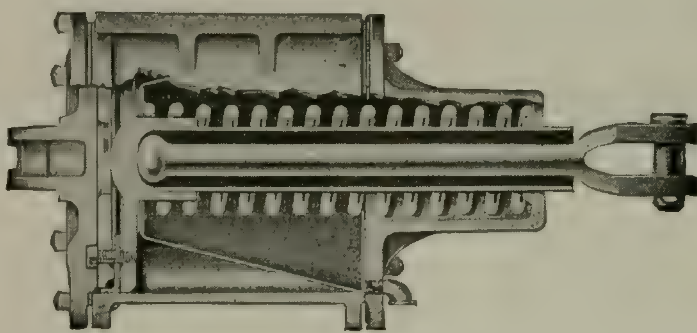

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OF
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*J. H. McCONNELL	October 1901, to October, 1903
*L. H. TURNER	November, 1903, to October, 1905
F. H. STARK	November, 1905, to October, 1907
*H. W. WATTS	November, 1907, to April, 1908
*D. J. REDDING	November, 1908, to October, 1910
*F. R. McFEATTERS	November, 1910, to October, 1912
†A. G. MITCHELL	November, 1912, to October, 1914
*F. M. McNULTY	November, 1914, to October, 1916
J. G. CODE	November, 1916, to October, 1917
*D. M. HOWE	November, 1917, to October, 1918
*J. A. SPIELMANN	November, 1918, to October, 1919
H. H. MAXFIELD	November, 1919, to October, 1920
FRANK J. LANAHAN	November, 1920, to October, 1921
SAMUEL LYNN	November, 1921, to October, 1922
D. F. CRAWFORD	November, 1922, to October, 1923
GEO. D. OGDEN	November, 1923, to October, 1924
A. STUCKI	November, 1924, to October, 1925
F. G. MINNICK	November, 1925, to October, 1926
G. W. WILDIN	November, 1926, to October, 1927
E. J. DEVANS	November, 1927, to October, 1928
W. S. McABEE	November, 1928, to October, 1929
E. W. SMITH	November, 1929, to October, 1930
LOUIS E. ENDSLEY	November, 1930, to October, 1931
JOHN E. HUGHES	November, 1931, to October, 1932

*—Deceased.
†Resigned.

Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING

DECEMBER 22, 1932

The meeting was called to order at 8:30 o'clock P. M. with President F. I. Snyder in the chair.

Attendance, as shown by registration cards, 132, as follows:

MEMBERS

Altsman, W. H.
Babcock, F. H.
Bald, E. J.
Balzer, C. E.
Beam, E. J.
Berg, Karl
Campbell, J. T.
Cannon, T. E.
Carlson, L. E.
Carruthers, G. R.
Carson, John
Chilcoat, H. E.
Christy, F. X.
Church, S. L.
Clark, C. C.
Conway, J. D.
Cunningham, J. L.
Cunningham, R. H.
Dambach, C. O.
Davis, Charles S.
Dickinson, T. R.
Diven, J. B.
Edwards, C. H.
Emery, E.
En Dean, J. F.
Endsley, Prof. Louis E.
Flinn, R. H.
Forsberg, R. P.
Frauenheim, A. M.
Fry, L. H.
Gilg, Henry F.
Glenn, J. H.
Hansen, William C.
Holmes, E. H.
Honsberger, G. W.
Hoover, J. W.
Huston, F. T.
Irwin, R. D.
Keller, R. E.
Klassen, F. G.
Kramer, W. E.
Kraus, Raymond E.
Kruse, J. F. W.
Kummer, Joseph H.
Lanahan, Frank J.
Lee, L. A.
Long, R. M.
Lynn, Samuel
Miller, John
Mills, C. C.
Misner, George W.
Mitchell, F. K.
Mitchell, W. S.
Moore, Donald O.
Morgan, A. L.
Morgan, Homer C.
McGeorge, D. W.
McIntyre, R. C.
McKinley, John T.
Nash, R. L.
Neff, John P.
Orchard, Charles
Paisley, F. R.
Pickard, S. B.
Rauschart, E. A.
Reeve, George
Richardson, H. R.
Rushneck, G. L.
Schmitt, Raymond F.
Searles, E. J.
Seiss, W. C.
Sekera, Charles J.
Severn, A. B.
Shelly, D. L.
Simons, Philip
Snyder, F. I.
Stamm, Bruce B.
Stoffregen, L. E.

Stucki, A.
Sutherland, Lloyd
Thomas, T.
Trax, L. R.
Tucker, J. L.
Van Blarcom, W. C.
West, Troy
Wildin, George W.
Wheeler, C. M.
Woodward, Robert
Wurts, T. C.
Yarnall, Jesse

VISITORS

Altenkof, Norman
Balzer, Charles
Beck, J. F.
Beyer, Coletta M.
Brandt, H. C.
Butckness, Joseph
Campbell, T. R.
Clark, F. T.
Clark, L. E.
Cooper, J. P.
Dauk, S. A.
Davidson, T. C.
Davis, William B.
Dittman, G. F.
Fritz, Joseph G.
Giles, J. T.
Guidotti, Bette
Guidotti, Harry
Hogle, J. A.
Houston, Leo
Howe, E. K.
Hutchinson, A. H.
Joice, B. S.
Keiner, Prof. Richard
Lanning, F. Frank
Lesko, Andrew
Lewis, Ralph S.
Lewis, S. B.
Lewis, Stephen B.
Long, Carl J. W.
Meily, R. P.
Mitchell, Paul S.
Robinson, H. J.
Rowe, Joseph
Rutter, H. E.
Searles, J. D.
Slocum, R. L.
Smith, Melvin
Smith, Sion B.
Hamm, J. D.
Stephan, S. M.
Worstell, Edward

A very enjoyable musical program was presented by Mr. Harry Guidotti and his Hawaiian Musicians, also Mr. A. H. Hutchinson, Tenor Soloist, of the P. & L. E. R. R., accompanied on the piano by Professor Richard Keiner.

PRESIDENT: I am sure we all highly appreciate this very delightful entertainment that has been given us by these musicians.

We come now to the business part of the meeting. The minutes of the last meeting have been printed and distributed and as you have all received the printed Proceedings, their need be no reading of the minutes. We have a complete record of the attendance on the registration cards and there will be no roll call.

Next we will hear the reading of the list of applications for membership.

The Secretary then read the following list of applications for membership:

Bessolo, A. J., Assistant General Traffic Manager, Gulf Refining Company, Gulf Building, Pittsburgh, Pa. Recommended by F. I. Snyder.

Brice, A. E., Special Representative, Gulf Refining Company, Gulf Building, Pittsburgh, Pa. Recommended by F. I. Snyder.

Coakley, J. A., General Traffic Manager, Subsidiary Companies of U. S. Steel Corporation, Carnegie Building, Pittsburgh, Pa. Recommended by F. I. Snyder.

Crawford, A. M., Supervisor Telegraph & Signals, Pennsylvania Railroad, Pennsylvania Station, Pittsburgh, Pa. Recommended by C. G. Crove.

Dihle, James E., Locomotive Engineer, P. & L. E. R. R., Fourth Avenue, Beaver Falls, Pa. Recommended by George L. Henderson.

Lanning, J. Frank, President, J. Frank Lanning & Company, 327 First Avenue, Pittsburgh, Pa. Recommended by E. A. Rauschart.

Rutter, Harley E., Electrician, Duquesne Light Company, 101 Grandview Avenue, Mt. Washington Station, Pittsburgh, Pa. Recommmended by Louis E. Stoffregen.

Smith, Charles F., 103 Sixth Street, Pittsburgh, Pa. Recommended by J. D. Conway.

Weber, Robert J., Special Representative, Westinghouse Electric & Manufacturing Company, Gulf Building, Pittsburgh, Pa. Recommended by F. I. Snyder.

PRESIDENT: These proposals will be referred to the Executive Committee, in accordance with our By-Laws, and upon approval by that Committee the gentlemen will become members without further action of the Club. Is there any other business to be brought up at this time?

SECRETARY: Since our last meeting we have received information of the death of the following members: P. L. Lobez, Designing Engineer, died November 16, 1932; J. B. Reed, McKees Rocks, Pa., died December 14, 1932, and J. B. Yohe, Retired Vice-President, P. & L. E. R. R., died December 18, 1932. Mr. Yohe was a charter member of the Club and took part in its organization on October 18, 1901.

PRESIDENT: An appropriate memorial minute will appear in the next issue of the Proceedings.

In regard to Mr. Yohe, who was a Charter Member of this Club, most of the men in this room knew him personally. Knowing Mr. Yohe was not simply an acquaintance, but it was a real friendship. His personality was such that acquaintance responded in a way that developed into real friendship. While he has not been so active in the last year or two in business, he is well remembered by the members of this Club, and there should properly be some special mention of his passing in view of the fact that he was a Charter Member.

We have for the subject this evening something that probably not many of us know very much about, electrons. It sounds a little bit spooky. "Electrons at work and at play," is the subject that will be presented to us by Dr. Phillips Thomas, Research Engineer of the Westinghouse Electric and Manufacturing Company. He has a number of most interesting experiments for us.

ELECTRONS AT WORK AND AT PLAY

By DR. PHILLIPS THOMAS, Research Engineer,
Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

DR. PHILLIPS THOMAS: Mr. President and Gentlemen:

I am going to show you, tonight, a few of what may be called "by-products of radio."

Every new art—radio is no exception—during the course of its development, brings to light a number of ways in which the new developments and discoveries may be used in furthering the older, more established arts. During the course of intense work on the new art proper, these by-products are temporarily shelved; when some measure of saturation is reached, the by-product possibilities are taken off the shelf, polished up and, in their turn, intensively developed.

The concentrated, intense work on the radio tube or radiotron as it is now known, of course, uncovered several ways of using these tubes in other than radio work, and also brought about the development of several other types of vacuum and gas-filled tubes, the best known of which are the phototube or so-called "electric eye," and its associated relay or amplifier tubes, the hot and cold cathode grid-glow tubes. It is in the main applications of these three tubes which form the groundwork of our demonstration this evening.

Since all electrical manifestations have to do with the flow of electric current, and this latter is dependent entirely upon the movement of electrons, I thought you might be interested in a few statistics as to the size, weight and cost of the electron.

Before the advent of the radiotron and similar devices, the older theories of the flow of current were quite adequate to explain all of the then-known types of conduction of electricty. These theories, however, would not account for the flow of electricity through vacua or highly rarefied gases, and it was expressly for the purpose of accounting for such types of conduction that the electron theory was developed.

According to the older theories, the chemical atom was supposed to be the smallest known particle of matter, and was thought to be indivisible. The new electron theory, however, states that there are very much smaller particles of matter, namely, electrons, and that each atom consists of two or more electrons spinning in regular orbits around a nucleus. The electron bears to the atom about the same size ratio as that of a flea to an elephant, and knowing you are familiar with the average elephant, I think you will agree that this is a very large ratio. Besides the more scientific differences, there are two others, between electrical and ordinary fleas, which give one great comfort, when one has to work with the electrical kind. These are: that the actions of electrical fleas or electrons can be depended upon, absolutely, under all circumstances—and that it is never a source of embarrassment to be obliged to talk about them in public.

When we come to consider the weight and cost of electrons, we must remember that electrons constitute a current (electrons in motion) and current is of itself worthless; we do not buy current; we pay for the product of current, voltage (pressure) and time. So let us suppose we are interested in the purchase of electric energy at 110 volts pressure, like the lights in the room here, and at an average price of 5c per kilowatt hour. We find that we can get for a nickel, something more than 230,000 billion billion electrons.—Well, I see that that figure makes the same impression on you as it did no me when I figured it out—namely, none at all—and I am glad that is so, because it shows me that my mind is neither more nor less than average; a thing which I have doubted at times, and I believe you would also, if you had to work continually with gadgets and things such as these on the table, as I have to do. And so perhaps we had better look into the thing a little farther; possibly we shall make confusion worse

confounded, possibly we may be able to clear the matter up a little.

Suppose we should enlarge our nickel's worth of electrons to the size of oranges, and make a cubical container just large enough to hold that number. We should find the cube would be 700 miles on a side. Now all the people now living could be put without undue crowding into a box 100 miles on a side. If we should knock out one side of the 100 mile box in some way, the people would fall out, under gravity, at the rate of one million per second. I shall let you figure out how large a hole to cut in our 700 mile box, to let the electron oranges flow out at the same rate; assuming that that has been done, we should find that the 100 mile box would empty of people in 15 minutes, while the 700 mile box would not be empty of electron oranges in less than 7 billion years.

I do not believe I have made the matter of weight of electrons a bit clearer by this analogy—so let us try once more. Suppose there were a retail store, into which we could go and buy free electrons over the counter, just as we go now into the corner grocery and buy, say, spinach. I do not like spinach any better than you do—it was the only thing that occurred to me just then. And while I am on the subject, let me issue a large round invective against the consummate scoundrel who first perpetrated spinach on an innocent, unoffending public. It seems to me I have been eating spinach all my life. When I was a kid, I ate it because my parents told me it was good for me—and in those days at least, one's parents were the final authority on such subjects! Now I eat spinach as an example to the children.

Now, returning to our electrical spinach—it was electrical fleas at first, then oranges, now spinach—just an example of the sort of sleight-of-hand tricks the electrons are so good at doing, let us enter our retail store and ask the clerk to wrap up for us an ounce of electrons. He does so, hands them over the counter and charges us for them, no less a sum than $5,000.

There, ladies and gentlemen, is a figure that really will give you some idea of how extremely small and light these things are. You can get for a nickel 230,000 billion billion of them—100 billion times as many dollars as there are in the world, and yet you must pay $5,000 for one little ounce. Incidentally, I should not envy you the job of taking home your ounce of them, because the simple quotient of 5,000 dollars by 5c shows that associated with each ounce of free electrons, would be something like 100,000 kilowatt hours of potential energy. That compares quite favorably with the

energy of a normal charge of T-N-T, and if that energy should be released in some way, I do not believe you would ever get home, or the electrons either.

Now that you know just how large, heavy and expensive electrons are, let us proceed to show you some of the things they do when they are at work and at play. And since most of the demonstrations have to do with radio tube derivatives, it seems no more than fair to show you first the daddy of all radio tubes—this tube in the long black box. The complete device we call the cathode-ray oscilloscope. Its purpose is to look at actual electrical waves, while they are waving as it were, and exactly as though they had been frozen permanently into the wave shape.

The tube has the same elements as your home radiotron. It has a filament and a grid to control the electron stream boiled off from its filament, and a plate to sweep the electrons across the intervening space. The only difference is that there is a tiny hole in the plate, through which some of the electrons pass instead of falling on the plate. They then become a current, in free space, without a wire, and they finally fall on the sensitized end of the tube and make the green spot that you now see.

You know what happens when you put a wire carrying a current into a magnetic field. The wire tends to move out of the field. While that really happens, it is not the whole story; if you stop the current flow, there is no more tendency for the wire to move. So what really happens is this: the current tries to move out of the field, and it cannot get away from the wire, so it takes the wire along with it.

Here, after the electrons go through the hole in the plate, we have a current without a wire, and so we should be able to move it out of a field, and much faster than in the case of the wire, because we no longer have to speed up the mass or inertia of the wire. So we have arranged a way to produce two magnetic fields across the tube, where the stream of free electrons is flowing; a vertical field, and a horizontal field.

By means of a certain special kind of radio-type oscillator, we cause the spot of light to move slowly from left to right, as you see and then to snap back and do it all over again. As the tubes of the oscillator warm up, the speed of the double motion becomes so high it looks to you like a steady line across the tube. Now, let us apply the wave under question to the other field coils so as to make the spot follow, vertically, the wave form we wish to see. Now if we adjust the speed of the horizontal line move-

ment and its snap-back, till it equals that of the wave, the spot will trace the wave-shape across the screen, snap back, and do it over again in exact time with the wave; and if this happens sixteen or more times per second, it will look to our eyes as though the waves were drawn right out, steadily, on the tube end (show a 60 cycle wave).

This is the wave-form of the sixty cycle energy applied to the room lights. As you see, it is a simple curve, smooth, with no ragged points or wavy places—what we call a sine wave. This is a very desirable thing in the wave-form of electrical supply, and the local power company is to be congratulated on the excellent shape of its voltage wave.

When one comes to the study of voice or sound waves, however, a pure sine-wave is the least desirable of all possible waves because the only thing that distinguishes one voice from another of the same pitch, or one musical instrument's tone from another of the same pitch, is the ripples, or overtones, or harmonics present.

By means of this microphone and amplifier, I am able to show you what my voice looks like (put out room lights, turn up amplifier gain). Now I am talking into the microphone, and you see my voice as well as hear it. You may not agree esthetically, and I shall not press the points, but electrically I claim my voice is a beautiful thing. As you see, It has quite well defined fundamental notes and very characteristic harmonics.

Do you remember when we had no dial telephones? At that time it happened quite often, that when one asked the Central for a number having a *three* in it, one got a *two* instead. That was because the only difference between the "eeeeee" sound and the "oooooo" sound is the harmonics present. Here is the "oooooo" sound, see how free from harmonics, and here is the "eeeeee" sound at the same pitch. See how prominent the harmonics are in the "eeeeee". Now in the earlier days, before the advent of vacuum tubes and radio, telephone apparatus had not been sufficiently developed to be able to transmit sounds of such high pitch as the harmonics in the "eeeeee" sound. Hence, the operator quite clearly heard you ask for a two, although in reality your request was for a three. The listening public has become so tone conscious, due to the widespread use of radio broadcasts that the telephone company has long ago refined its apparatus to the point where it does transmit higher pitches quite faithfully; and so, even where the dial is not yet in use, one seldom if ever finds the "wrong number"

mistake being made any more. In fact, telephone operators are now being instructed no longer to trill their threes, as they did for so long.

The oscilloscope is used in the laboratory for wave analysis, as I have shown you. It is used by radio broadcast stations, to compare the electrical copy of the sound wave as it originates in the studio, with the wave they propose to put on the air at the transmitting station. If there is any difference between these two waves, it is due to poor lines between station and studio, and must be corrected before perfect transmission can be secured. The oscilloscope can also be used in deaf schools, to enable deaf people to see what they say, although they cannot hear it. They can imitate the lip motion of their teachers, and compare the appearance of the sounds they make, with that of supposed same sound by the teachers.

To make an actual mathematical analysis, quantitative, of a wave with this instrument, one must take a time photograph of the green wave pattern on the screen, after which it may be analyzed in any standard way.

So much for the radio tube. The first by-product I shall show you is the hot-cathode grid-glow tube. I shall demonstrate only one application of this tube, and that is the stroboglow, or stroboscope using a glow tube. This glow tube is here used as a relay, pure and simple. It is an all-or-nothing proposition; it either passes no current, or all the current it is capable of passing, depending on the voltage condition of the control electrode, which we call the grid from its similarity to the grid of a standard radiotron.

This tube has also three electrodes, just like a radiotron. It is filled, however, with Neon gas, so it makes a bright light if much current is passed through it. We have found that a condenser can be discharged through it, almost as readily as though a wire is connected across the charged condenser terminals. The discharge causes a bright glow in the Neon gas and it lasts for only three-tenths of one millionth of a second. In that short time an automobile going sixty miles an hour would move less than one one-thousandth of an inch.

Here, then, we have a means of producing a very bright light, which lasts a very short time, and by controlling and timing the voltage change on the control grid we can make as many of these flashes of light per second as we please. Thus we have an excellent stroboscope; a means of illuminating a rapidly rotating body,

once per revolution and thus making the body appear to stand still so that it can be examined just as though it really were still.

Notice this small fan. I plan to speed it up to about four thousand R.P.M. and then tune the stroboglow light to the same speed and then if we view the fan blades by the stroboglow light alone, the fan should appear to stand still. Of course you can see this effect much better if the room lights are out, so if you will pardon me, I shall try to blow them out. (Blow out room lights).

Now the fan is up to speed, and I tune the stroboglow light to the same speed. You see you can read the letters on the blades just as well as when the fan was still. Also I can make it, apparently, move either fast or slowly, in the either direction. If everyone has seen this I shall shut down the fan and see if I cannot light the room light again with a match (light lights with match).

This appaartus—the stroboglow—is a tool of which we are very proud. Undoubtedly you have thought already of a dozen ways to use it, things to do with it. We have used it to determine the mechanism of erosion of the leading edge of airplane propeller blades in the rain; to locate the source of noise, in certain overhead valve automobile engines; to actually observe the runner blades on the wheel of a steam turbine, in actual operation, to see what frequecy and amplitude of vibration is being followed by the blades; and in numerous other ways.

Now let us turn to the other relay or amplifier tube, the cold cathode grid-glow tube, and its partner, the phototube. The reason I showed you this stunt of blowing out the lights and turning them on again with a match was not for entertainment entirely, but partly to bring out the extreme sensitivity of the cold cathode grid-glow tube. This tube, like its big brother the hot cathode tube, is a relay. It does or does not pass current, depending on the condition of its control grid.

Engineers judge the quality of a relay by its "ratio", the quotient of the power the relay can handle through its contacts by the power required to open and close the contacts. For standard electromagnetic relays, all the way from the smallest telephone relay to the largest circuit breaker, this ratio will be somewhere near two or three thousand to one. The ratio of this tube relay is 160 million to one, the most sensitive relay of which we have knowledge. Of course you can see that so small a tube as this cannot handle much power; it gets its high sensitivity by decreasing the denominator of the fraction. It takes almost a vanishing

amount of power to make the tube glow, or to shut it off when already glowing; and when I blew out the lights I simply deposited a small amount of moisture from my breath on this grid of platinum lines on a pyrex dish, which was connected to control the tube grid voltage. This moisture lowered the resistance of the grid circuit; a very small amount, it is true, but amply enough to operate the sensitive grid glow tube. Notice when I blow on the grid, now, that the tube stays lighted for some time after I stop blowing. That simply means that the moisture I have deposited on the grid takes some little time to dry off again, and the tube will not go out until that happens.

When the lights were lighted with a match, the match was held in front of a phototube connected in the same circuit with the breath grid; this lowered the circuit resistance just as the breath did with the same result.

Notice that we use here, the combination, phototube and grid-glow tube. The grid-glow tube takes the place of about three steps of standard transformer coupled amplification. Of course where one has to copy a wave form, as in television or broadcast work, there is no substitute for the amplifier, but for the relay work, we can greatly reduce size and weight and cost by the use of the grid-glow tube instead.

So many commercial applications of the phototube-grid-glow tube combination are being made that we at the Laboratories have coined a nickname for it. We call it the "PC-GG combination" for short. Its use makes it possible to control circuits from a distance, with a ray of light. In fact, that is the sort of application we like best just now,—the sort in which a ray of light is used as a weightless lever to open or close switches at a distance when for one reason or another it is not possible or is inconvenient to do so by the usual means. A good example of such applications is in the Pittsburgh steel mills—where it is desired to put a newly cast ingot into a soaking pit. The operator drives up in his crane, carrying the ingot in its jaws. He comes somewhere nearly in position over the soaking pit he intends to use. Then he turns on a small light in the cab of the crane and moves the crane back and forth until the light falls on the phototube of a PC-GG combination on the wall under the crane girder. When the light has shone on the phototube for a second or two, the soaking pit cover automatically opens and the operator lowers the ingot into the pit, withdraws the crane jaws and simply drives away. After a second or two the pit cover

closes automatically because the light no longer is shining on the phototube.

Most of the actual commercial applications of the PC-GG combination are either too large and unwieldy to carry around on lecture trips or are not interesting to an average audience. So we have worked up several laboratory applications of a non-commercial nature. These have the same factual basis as regular practical applications, and they are simpler, easier to understand and easy to carry around. To illustrate the use of a light beam as a weightless lever used to operate switches at a distance, we have worked up a modern version of the old William Tell legend.

In our illustration of the old legend, the dummy figure here represents Tell Junior, and I for the time shall represent Tell Senior. Of course if the venerable tale is true, it consisted of a wager between Tell Senior and someone else that he could not shoot the apple off his son's head. To prove that he could, or to go through with the wager, Tell Senior had to send retainers into the forest to cut down a yew tree and make a bow from its heartwood. The bow had to be cut and finished carefully to fit in length and strength the good right arm of Tell Senior. Then other yoemen had to cut down an ash tree and make from it an arrow, beautifully straight, and properly tipped and feathered so that horizontally at least, it would travel in a straight line. But arrows have considerable weight and do not travel very fast, as you know, and so Tell Senior had to call in the Court Mathematician to calculate the trajectory of the arrow, to tell where to aim it, so that it would hit the apple instead of hitting Tell Junior in the ear, say. And after all that was said and done, I should be willing to wager, in my turn, that Junior had no more than one chance in a thousand.

In these days of speed and efficiency we could not be bothered with such a mass of detailed work to go through with such a simple wager and so we shall re-enact the actual shooting by means of a weightless arrow, a beam of light. For sentimental reasons, however, we retain the ancient form of bow and arrow, and here is the formidable weapon with which I propose to do the trick. Notice as I point the arrow at you, that it is quite harmless. All that leaves the bow when I pull the bowstring is a bright flash of light. As far as I am concerned, the court mathematician would be out of a job because light goes where you point it, at least for finite distances; and we can cheat by using the small, dim light emanating from the arrow to aim at the phototube behind Junior's head. Now

you watch the apple and I shall pull the bowstring on the count of three. One, two, three.

Of course such a stunt as that has no practical value, at least in that form, but the kids in the audience, if not many of the grown-ups, might be able to use it, if the bow and arrow were replaced by a revolver which we could take to bed with us, and so be able to shoot the alarm clock off of the table in the morning, instead of having to kick it off as we do now. But it does show pretty well the use of a light beam as a weightless lever to operate switches at a distance.

Another application of the PC-GG combination, often made, is in counting things. Counting finished manufactured goods as they move along on an endless conveyor belt; counting automobiles as they enter and leave the Holland Tunnels under the Hudson River, from New Jersey into New York City. To show how faithfully the combination can count, we have worked up a device which we call the "Photomatic Telephone". In this metal box on the table, there is mounted a phototube, here, and the associated grid-glow tube on top, so that you can see it glow whenever light strikes the phototube. Also mounted in the box is a complete miniature telephone central station, one position of a telephone dial board. When a short flash of light strikes the phototube, the apparatus dials one, one for each flash. When a longer flash is used, instead of dialing or notching up one, the apparatus operates any circuit that may have been connected by the short flashes.

Back on the table in the auditorium is a complete telephone dialing and talking outfit. The only difference between this and the transmitter at the subscriber end of a telephone line, is that instead of sending current impulses into a wire line this one sends light flashes, one for each digit dialed over through the air to the receiving phototube; and sends a longer flash of light over when one speaks into the microphone. Now I shall put out the room lights, then go to the transmitter and see if we cannot make it count dialed numbers correctly and operate certain electrical circuits; it cannot do this latter unless it counts the dialed numbers correctly.

(Demonstrate. Final circuit,—turns on the room lights again).

I think this shows you that at least at telephone dialing frequency and at least as high as nine in a single number, the PC-GG combination can count correctly.

The next thing I have to show you has to do with the control of fire. Ever since the beginning of civilization, engineers and

others have been concerned with problems of getting the most in light and heat out of combustion and of preventing the combustion from getting out of bounds. Witness the enormous and beautifully specialized fire-fighting departments in all large cities.

For the last fifteen or twenty years, much progress has been made along the line of the adage of the "ounce of prevention". The best example of this progress is the modern sprinkler system seen so frequently in public buildings, storerooms and the like. But I submit that there are two things wrong with the sprinkler system. In the first place it depends on the heat from the fire instead of on its light, so that the fire must attain considerable size before enough heat reaches the ceiling to melt the wafer which permits the sprinkler to function. In the second place the blooming thing has no sense at all and goes right ahead extinguishing, long after the fire is out and we read in the morning papers how much more damage resulted from water than from the fire itself.

Here in this box we have a really modern fire fighter—we call it the "Fire Scanner" which was built to overcome these two defects. It has the usual PC-GG combination in the box and mechanically associated with it, a Sprengel aspirator much like that used to inject water into locomotive boilers. At the back, here, is a cylinder of carbon dioxide liquid, under 1000 lbs. pressure, which can be turned on by means of this electromagnetic valve.

When we turn on the fire scanner, it goes from side to side and up and down, as you see, looking for fires on this screen. When it sees a fire it stops when pointed exactly at it, turns on its extinguisher and puts it out. There is the first point—the light from the fire is used to cause it to be put out. Then, when the fire is out, it has no more interest in that fire. Just as when you or I are driving along a country highway and meet with a near accident that nevertheless does not materialize,—why, that's that, and we drive on to the next accident,—so this fire scanner starts, automatically, as soon as one fire is out and goes on looking for more fires to put out. Now I shall light three or four fires here on the screen, let them burn a moment to stop dripping. Now watch it!

The farther we go in developing machines to perform the duties of people, without ever having to eat, ever sassing the boss or asking for a raise, the more prone the machines seem to be to "sneak up and put one over". One of the professors at Princeton had the right idea, when he spoke of the "Innate Cussedness of Inanimate Machinery"! I remember when I was developing this

fire fighter,—once I stood between the machine and the screen while lighting the fires, forgetting that it had been turned on. It caught a glimpse of a fire over my shoulder. Of course I had to go change my clothes; but that was not the point. I would almost be willing to take oath in court, I heard the blamed thing chuckle.

Now, ladies and gentlemen, in closing I should like to leave just two thoughts with you. First, please do not confuse most at least of the things I have shown you, with the serious work being done at East Pittsburgh. I have told you why we show you this sort of device rather than actual practical applications; as the Germans say, we do not want you to fail to "see the forest because of the trees",—to become so interested in special technical features of developments, that you lose sight of the principles at bottom. And second, I realize, none better, that this is a dry, technical, uninteresting sort of subject,—and I am surprised, pleased and more than a little touched by your very flattering attention. I thank you.

PRESIDENT: It is customary after a speaker has presented a subject before the Club to announce that if there is anything you wish to ask the speaker now is your opportunity. If there is anything at all that you do not know about electrons just ask Dr. Thomas. He did not say that he would answer everything you might ask, but we will take a chance.

DR. THOMAS: I shall certainly not be able to answer every question that might be asked, but I will do the best I can.

PRESIDENT: If there are no questions, does any one wish to say something on his own account? There are a number of people here who are qualified to give us something on this subject.

Mr. R. P. Meily, Transportation Manager of the Westinghouse Electric & Manufacturing Company, may we hear from you?

MR. R. P. MEILY: Mr. President and Gentlemen: As a supplement to Dr. Thomas' demonstration of the Stroboglow, I believe you will be interested in a practical application which the Westinghouse Company has made of this instrument.

The Turbine Design Engineers wished to know how a new type of low pressure blading was behaving under operating conditions. This was accomplished by cutting a suitable window in the turbine casing and covering it with heavy Pyrex glass. With the Stroboglow, any one of these blades could be singled out and made to appear as standing still before the window, with the machine up to

speed and delivering full load. In this way it was possible to study how the blade would act under all conditions of speed and load.

DR. THOMAS: There is one point I would like to bring out on the subject suggested by the last speaker's description of the very interesting research. That is when one looks at a single piece rotating, as we did with the letter "P" on the blade of the fan, you simply got the letter "P" and nothing else. When you look at a turbine in revolution you do not see a composite of a number of blades, you see only one individual blade, and your eye carries the image from one revolution to another.

PRESIDENT: Anybody else? Mr. R. H. Flinn, General Superintendent, Pennsylvania Railroad, have you anything to give us?

MR. R. H. FLINN: I have never had any experience in the practical application of this sort of thing but it has been a very interesting demonstration and I appreciate very much the opportunity to be here and to see some of these things and have Dr. Thomas explain them so lucidly.

PRESIDENT: Mr. J. B. Diven, Superintendent of Motive Power, Pennsylvania Railroad. May we hear from you?

MR. J. B. DIVEN: This has been a very interesting talk and I have enjoyed it very much. There is just one thing I would like to ask the speaker. He is able to do so much that is almost miraculous, I wonder whether this PC-GG combination could be used to detect and cool a hot box while the train is in motion, without stopping the train.

DR. THOMAS: I shall not take that too hard, but rather in the spirit in which the question was asked. But we are able to do just that very thing, but of course not with the equipment you see here.

While we are on the subject of railway applications, you may be interested in one we tried to make on one of the railroads in the West coming into Chicago. They asked us if we could count car wheels on freight cars going over a piece of track. We found that at least for the extremes of speed of the freight cars it was too fast for the capacity of the apparatus to properly count. The failure, however, was not due to the apparatus itself but in the mechanical relays which it was found would not pull up quickly enough.

PRESIDENT: There are a number of electrical men here who should be able to add to the discussion. May we hear from any of them as to any practical application of these principles?

I presume you feel like I do that this is a subject that is pretty good to listen to but not to get in on. We do not know much about it. Mr. Dambach, have you anything to say?

MR. C. O. DAMBACH: Mr. Chairman and Fellow members: When I read the subject of the paper for the night I was fearful that it would be too technical to be appreciated by a number of our non-technical members, however the Doctor's homely illustrations have permitted all of us to have a better understanding of the subject about which we will know considerably more probably in the future.

Personally I enjoyed this paper very much and I believe the same is true of all those present therefore I move we give a rising vote of thanks to be offered Dr. Thomas for his very interesting and instructive experiments which we witnessed this evening.

Motion prevailed by unanimous rising vote.

PRESIDENT: Before we adjourn I would like to say that the registration cards indicate that we have more than forty visitors here this evening and we are glad to welcome them to our meeting. I would add that every one of you gentlemen is eligible to membership in this Club. Your presence indicates an interest. That is about all we require in the way of eligibility. The Secretary has application blanks here and we would be glad to have any of you sign up. The annual dues are very low when you consider what you get out of the Club. Nine meetings and the printed Proceedings, with a lunch after the meetings and an opportunity to meet a lot of good men in good fellowship.

For the Club and on behalf of its officers I wish for you a Merry Christmas and a happy holiday season. In ten days this year will have passed and we are looking forward to better things in the coming year, better things that we feel are right ahead of us. The meeting is now adjourned.

J. D. CONWAY, Secretary.

In Memoriam

P. L. LOBEZ

Joined Club January 23, 1903

Died November 16, 1932

J. B. REED

Joined Club November 26, 1929

Died December 14, 1932

J. B. YOHE

Charter Member, joined Club October 18, 1901

Died December 18, 1932

RESERVED

OFFICIAL PROCEEDINGS

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The Relation of Locomotive Operation to Operating Income

By THOMAS R. COOK, Manager, Inspection & Field Service,
The Baldwin Locomotive Works, Philadlephia, Pa.

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OF

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Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING
JANUARY 26, 1933

The meeting was called to order at the Fort Pitt Hotel at eight o'clock P. M., with President F. I. Snyder in the chair.

Before taking up the regular program of the evening Messrs. Robert S. Binkerd, S. McNaughton and Charles E. Hale of The Baldwin Locomotive Works, being called upon, rendered a couple of songs which received hearty applause.

Attendance, as shown by registration cards, 233, as follows:

MEMBERS

Allison, John
Altsman, W. H.
Ambrose, W. F.
Babcock, F. H.
Bailey, J. C.
Bair, J. K.
Beam, E. J.
Beaver, Roy C.
Beeson, H. L.
Berg, Karl
Bradley, W. C.
Britt, T. E.
Brown, E. L.
Buffington, W. P.
Bull, R. S.
Burgham, M. L.
Cannon, T. E.
Carlson, L. E.
Carson, John
Chittenden, A. D.
Christy, F. X.
Clark, C. C.
Conway, J. D.
Crawford, D. F.
Cunningham, W. P.
Dambach, C. O.
Davies, James
Dihle, James E.
Down, S. G.
Downes, D. F.
Dunbar, Harold F.
Durkin, James E.
Emery, E.
Emsheimer, Louis
Endsley, Prof. Louis E.
Ferguson, R. G.
Fischer, G. E.
Forsberg, R. P.
Frauenheim, A. M.
Freshwater, F. H.
Fry, L. H.
Furch, George J.
Gilg, Henry F.
Gillespie, J. Porter
Glaser, J. P.
Glenn, J. H.
Goda, P. H.
Gray, Guy M.
Hale, C. E.
Haller, Nelson M.
Hansen, William C.
Harman, H. H.
Harper, G. C.
Hastings, W. S.
Hepburn, P. W.
Herrold, A. E.
Hill, Harold A.
Hill, W. D.
Hilstrom, A. V.
Hohn, George W.
Holmes, E. H.
Honsberger, G. W.
Hoover, J. W.
Huff, A. B.
Hughes, John E.
Johnson, W. M.
Johnston, H. F.
Keller, R. E.
Kelly, L. J.
Kirk, W. B.

Klassen, F. G.
Knox, William J.
Kohute, H. G.
Kraus, Raymond E.
Kruse, J. F. W.
Kummer, Joseph H.
Lanahan, Frank J.
Laurent, Joseph A.
Layng, F. R.
Leban, J. L.
Lee, L. A.
Leet, C. S.
Longdon, C. V.
Lowndes, T. H.
Lundeen, Carl J.
Lynn, Samuel
Mannion, M. F.
Manson, A. J.
Mayer, L. I.
Meily, R. P.
Miller, J.
Mills, C. C.
Misner, George V.
Mitchell, W. S.
Molyneaux, Dawes S.
Montague, C. F.
Morgan, Homer C.
Moses, G. L.
Muir, R. Y.
McAbee, W. S.
McFetridge, W. S.
McGeorge, D. W.
McKenzie, Edward F.
McKinley, John T.
Nagel, James
Nash, R. L.
Newell, J. P., Jr.
Nieman, Harry L.
Norris, J. L.
Nutt, Col. H. C.
Orr, D. K.
O'Toole, J. L.
Paisley, F. R.
Passmore, H. E.
Posteraro, S. F.
Pringle, H. C.
Ralston, J. A.
Rauschart, E. A.
Redding, P. E.
Rhine, G. B.
Richardson, E. F.
Rossell, R. T.
Rutter, Harley E.
Sanders, Maj. Walter C.
Schaller, A. J.
Schmitt, Raymond F.
Sekera, Charles J.
Severn, A. B.
Shafer, John S.
Sheridan, T. F.
Smith, J. Frank
Snyder, F. I.
Sterling, C. C.
Stevens, L. V.
Stevens, R. R.
Stoffregen, Louis E.
Stucki, A.
Sullivan, P. W.
Sutherland, Lloyd
Taylor, J. M.
Tuttle, C. L.
Urtel, E. J.
Van Blarcom, W. C.
Warfel, J. A.
Warner, Russell H.
Weaver, W. Frank
Webster, H. D.
Welch, E. M.
West, Troy
Whalen, D. J.
Wikander, O. R.
Wildin, George W.
Winslow, S. H.
Winter, Paul S.
Wright, John B.
Wyke, J. W.
Wynne, F. E.
Yarnall, Jesse

VISITORS

Apel, Charles E.
Baughman, G. W.
Beiger, John S.
Binkerd, Robert S.
Bishop, O. P.
Boggs, L. S.
Bond, S. O.
Breinig, Peter L.
Brown, W. G.
Burriss, H. E.

Callin, T. A.
Candee, A. H.
Cook, Thomas R.
Corrigan, W. E.
Curry, J. L.
Edwards, H. F.
Ellis, D. S.
Flatley, William J.
Follett, W. F.
Ford, J. R.
Forrester, J. B.
Freed, H. S.
Frobie, Joseph
Garlick, Robert
Goodwin, A. E
Gray, Robert H.
Guidotti, Harry
Horan, F. T.
Johnston, F. D.
Joyce, S. F.
Jungr, H. J.
Kapp, A. C.
Kester, M. B.
Knoke, H. C.
Lasko, Andrew
Leech, R. W.
Lewis, S. B.
Lincoln, J. J., Jr.
Link, A. J.
Livinston, J. C.
Logan, J. W.,Jr.
Lundeen, R. G.
Martin, Gilbert, Jr.
Metzger, C. L.
Metzger, Richard E.
Miller, George
Miller, Paul John
Miller, T. P.
Mitchell, John W.
Moore, M. K.
Mussey, D. S.
McGeary, E. J.
McIlroy, J. E.
McNaughton, S.
Oldham, R. W.
Pickels, H. D.
Schadt, A. D.
Schwab, John A.
Severn, Harry A.
Shultz, O. E.
Skellie, W. A.
Smethurst, W. A.
Smith, D. J.
Smith, Sion B.
Smith, W. H.
Stevenson, L. N.
Thomas, A.
Terkelsen, B.
Tovey, L. A.
Tripp, W. C.
Vencill, A. L.
Vollmer, Paul F.
Woldwar, V. E.
Woods, G. M.
Yetso, John J.

PRESIDENT: The Proceedings containing the minutes of the last meeting are in print and you will receive them in a few days, therefore we will dispense with the reading of the minutes.

If you will all sign the registration cards we will have a complete list of the attendance without a call of the roll.

The Secretary has some proposals for membership to be presented to the Club at this time.

SECRETARY: I have the following proposals for membership:

Bailey, J. C., Car Service Agent, B. & L. E. R. R., 350 Main Street, Greenville, Pa. Recommended by F. I. Snyder.

Beaver, R. C., Assistant Mechanical Engineer, B. & L. E. R. R.,

122 West Main Street, Greenville, Pa. Recommended by F. I. Snyder.

Britt, T. E., Division Storekeeper, B. & O. R. R., 2319 Walton Avenue, Overbrook, Pittsburgh, Pa. Recommended by E. A. Rauschart.

Carran, E. W., President, E. W. Carran & Sons, Covington, Ky. Recommended by E. A. Rauschart.

Ekey, J. S., Engineer of Bridges, B. & L. E. R. R., 4 College Avenue, Greenville, Pa. Recommended by F. R. Layng.

Hohn, George W., Track Supervisor, B. & L. E. R. R., 538 East Pearl Street, Butler, Pa. Recommended by H. H. Harman.

Kapp, A. C., General Foreman, B. & L. E. R. R., R. F. D. No. 1, Verona, Pa. Recommended by F. I. Snyder.

Mannion, M. F., Office Assistant to Chief Engineer, B. & L. E. R. R., 96 N. High Street, Greenville, Pa. Recommended by F. R. Layng.

McGeary, E. J., Trainmaster, B. & L. E. R. R., 34 Columbia Avenue, Greenville, Pa. Recommended by W. M. Johnson.

McLaughlin, F. P., General Superintendent Service Stations, Gulf Refining Company, Gulf Building, Pittsburgh, Pa. Recommended by F. I. Snyder.

Osborne, Raymond S., Mechanical Engineer, Sewickley, Pa. Recommended by J. D. Conway.

Richardson, E. F., Assistant to Engineer of Motive Power, B. & L. E. R. R., 57 Chambers Avenue, Greenville, Pa. Recommended by F. I. Snyder.

Skellie, W. A., Train Master, B. & L. E. R. R., Albion, Pa. Recommended by W. M. Johnson.

Urtel, E. J., Assistant Division Storekeeper, B. & O. R. R., 3936 Dalewood Avenue, Brentwood, Pa. Recommended by E. A. Rauschart.

Winter, P. S., General Car Foreman, B. & L. E. R. R., 42 First Avenue, Greenville, Pa. Recommended by F. I. Snyder.

PRESIDENT: In accordance with our By-laws these proposals will be referred to the Executive Committee and upon approval by that Committee the gentlemen will become members without further action by the Club.

SECRETARY: Since our last meeting we have received word of the death of two of our members, James H. Champion, Athletic Director, Pennsylvania Railroad, Blawnox, Pa., died April 17, 1931, and I. H. Milliken, Vice-President, McConway & Torley Corporation, Pittsburgh, died December 30, 1932.

PRESIDENT: An appropriate memorial minute will appear in the next issue of the Proceedings.

We have a very interesting subject for consideration tonight and the very good attendance attests the interest you have in it, "The Relation of Locomotive Operation to Operating Income". It will be presented by Mr. Thomas R. Cook, Manager Inspection and Field Service, Baldwin Locomotive Works. Mr. Cook has in the last few years been making some extensive studies in locomotive operating costs and the economies of the locomotive in railroad operation and he has prepared the results of those studies in a summary of the whole which he will present to us tonight. Mr. Cook.

THE RELATION OF LOCOMOTIVE OPERATION TO OPERATING INCOME

By THOMAS R. COOK, Manager, Inspection & Field Service, The Baldwin Locomotive Works, Philadelphia, Pa.

Net operating income is the gross income, receipts from freight and passenger traffic, less the expense of operation. The I. C. C. records show that the performance of the locomotive is the principal factor in over one-third of these operating expenses. Therefore, it is quite evident that the locomotive performance has a direct bearing on operating income and of a magnitude that makes it one of the most important points of attack in the reduction of operating expense.

As an example, assume a situation where the operating ratio is 85%, i.e. the railroad has a net operating income of 15% of the gross revenue. Now assume that the locomotive performance is responsible for one-third of the operating expense and by economic use of power, this portion of the expense can be reduced 20%. We would change a doubtful financial situation to one with an operating ratio of 79.3% and with a net income of 20.6% of the gross. In other words the reduction of only 20% in locomotive operating expense increases that percentage of gross income, which becomes net operating income, from 15 to 20.6, but this is a 38% increase in net operating income.

The locomotive is responsible for the following items of operating expense:

1. Locomotive repairs.
2. Crews' wages. (Engine and train crews.)
3. Fuel.
4. Enginehouse costs.
5. Lubrication.
6. Water.
7. Locomotive, other supplies.
8. Depreciation on locomotive inventory.
9. Taxes and insurance on locomotive inventory.

All but the first item are simple of understanding and control and will be discussed later under the subject of selection of power. The first item, "Locomotive Repairs," is quite complex. The Baldwin Locomotive Works have given this question detailed consideration for the past three years and we believe we have developed a method of analysis that allows of predetermination of repair costs and the relation of these costs to the locomotive inventory. At the start of our study we found that we were handicapped by the lack of a proper measuring stick. In the early days the cost of repairs per locomotive mile was adequate. The locomotives did not vary much in size and there was a more or less constant influx of new power. Therefore, the cost of repairs per locomotive mile gave the management a fair control of this item of expense. In the last ten or fifteen years the rapid increase in the size and hauling capacity of the locomotives necessitated special consideration in comparing repair expense.

Consider, for instance, a road, hauling its freight with Consolidation locomotives and a few light Mikados, suddenly putting into the inventory a fleet of 2-8-8-2's of double the tractive power of the old Consolidations. You cannot maintain 2-8-8-2's with 140,000 lbs. tractive power with the same amount of money per mile that you can a 2-8-0 with 35,000 lbs. tractive power. On the road in question the cost of repairs per locomotive mile began to climb. This and other similar cases meant the death of the cost per locomotive mile as a reliable control figure of the maintenance expense.

Some consideration was given to this question on roads having a considerable portion of large power and to some small extent the cost of maintenance was based on the cost per 100 tractive ton miles. This method would have been satisfactory if the element of speed had not come rapidly into the picture.

This latter element resulted in larger and larger boilers with increased steaming capacity and greater sustained tractive effort at speed and we find locomotives of the same tractive power with entirely different capacities for doing work. This is illustrated in Figure 1.

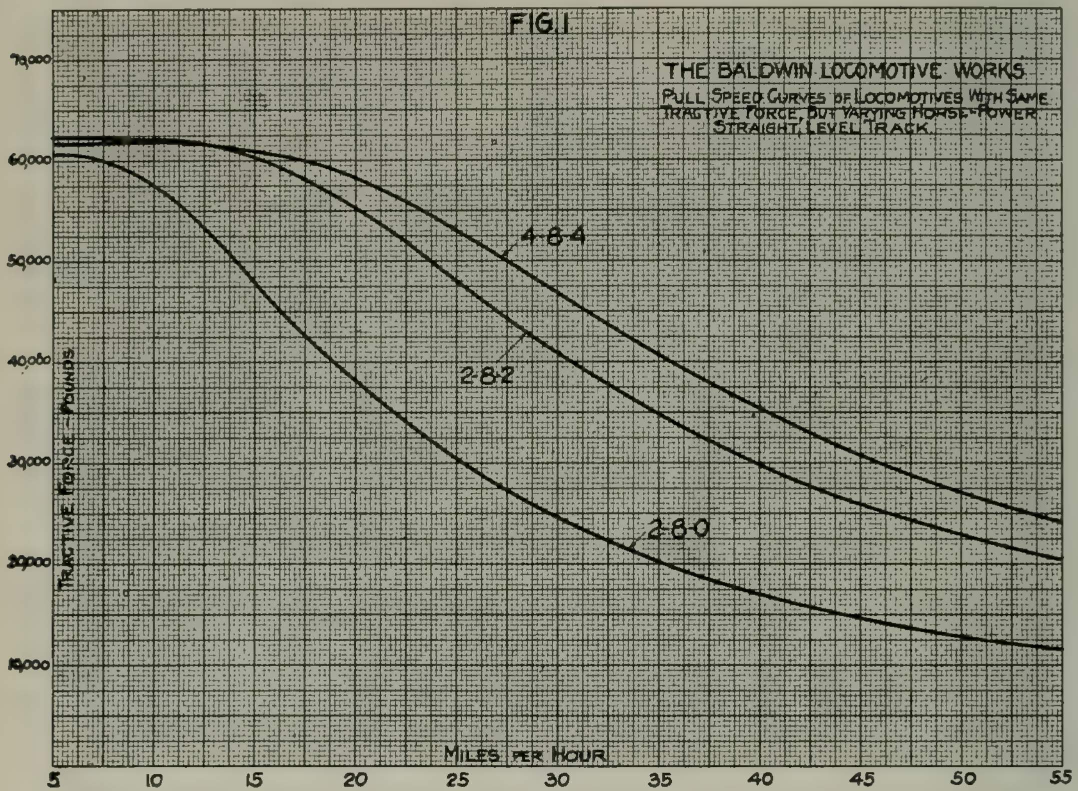

Figure 1

The tractive power of the locomotives shown is approximately the same, varying between 60,500 and 62,000 lbs. The 2-8-2 type has a greater capacity for doing work than the 2-8-0 and the 4-8-4 has a greater capacity for doing work than the 2-8-2. It naturally follows that the figure of maintenance cost based on tractive ton miles failed on account of the fact that it did not take into consideration the capacity of the machine for doing work.

We have found that locomotives are given work to do (Dynamometer Horse Power Hours) in proportion to their capacity for doing work and it is quite evident that the cost of repairs should be measured by the same standard, i.e. the ability to do work. For this purpose we have used the potential horse power of the locomotive. The method of computation of the potential horse power has been published from time to time in the past year (See Baldwin Locomotives of April 1932) and I will not take up your time this evening with the various details.

Briefly, the potential horse power of the locomotive is the amount of water the boiler can evaporate per hour divided by the lbs. of steam required per Indicated Horse Power Hour.

As the potential horse power of a locomotive is dependent to a great extent upon the size of the boiler, boiler horse power has been used as a synonymous term. For ease of handling the actual unit used, the Horse Power Unit is taken as 10,000 potential or boiler horse power miles. Therefore, the horse power unit performance of a locomotive in a year is its potential horse power multiplied by the miles it ran in the period divided by a constant, 10,000.

We have tried this unit out for three years on over 8,000 locomotives covering over 20,000 locomotive years and it has been found to meet the requirements of the case without exceptions, not only as a measuring stick for comparing cost of repairs, but as a factor to determine the tractive effort at various speeds and the economy of locomotive operation.

Having developed a proper measuring stick we immediately found that we were up against another variable that had to be given consideration. This was the age of the locomotive and it became quite evident that the cost of maintenance increased as the locomotive became older. The maintenance for the first year is relatively low. It increases rapidly to about the 5th or 6th year and shows a constant increase from this time on from 3% to 5% per year. In other words, it is not correct to say that a railroad has a cost of so many dollars and cents per horse power unit. The element of age must be taken into account and the correct statement will be that the railroad has a cost of so many dollars and cents per horse power unit at an average age of use of so many years.

The cost of maintenance in this paper (unless qualified) refers to the total cost, i.e. the combined classified and running repairs, and in all cases care has been taken to see that the figures used checked the railroad's 308 account.

In approaching a study of cost of repairs at varying years of age, it was necessary to determine the effect of economy measures that were taken by the roads in the period from 1920 to 1930. The changes, affecting our problem, are as follows:

1. Improved shop management.
2. Consolidation of shops.
3. Longer engine runs.
4. Predetermined mileage between class of repairs.
5. Water treatment.

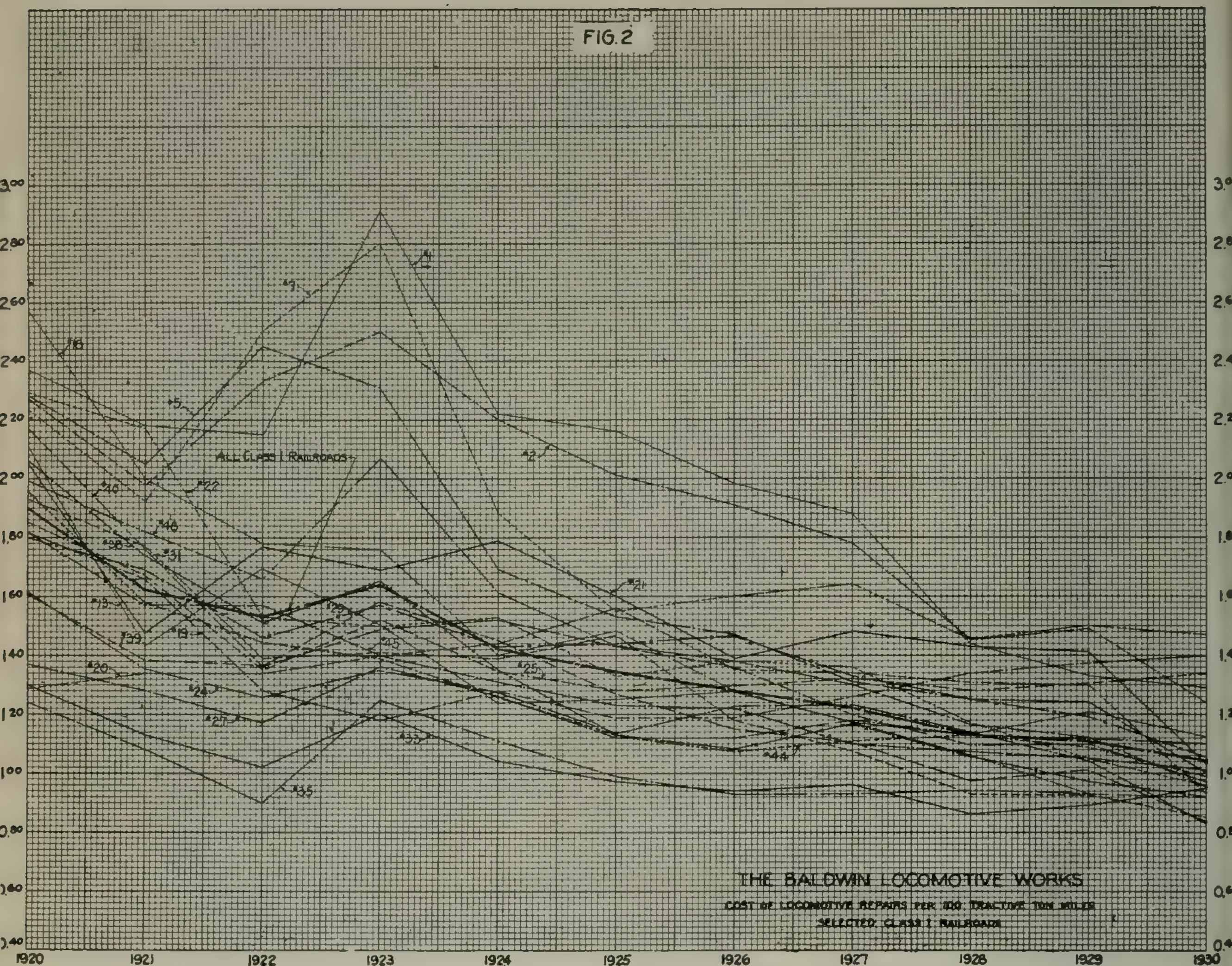

Figure 2

To obtain the results of these measures we calculated the cost of repairs on various roads from 1920 to 1930 using the 308 account divided by the tractive ton miles, this being the best information available. The tractive ton miles were obtained by multiplying the locomotive mileage of the given year by the average tractive power of the locomotive inventory. This method, of course, is not exact, but we feel it is comparative. The results obtained on some of the roads are shown in Figure 2.

It will be noted that in 1920 after the control of the roads was returned by the Government, a decided decrease in cost of repairs was made. This trend was disturbed by the shopmen's strike of 1922, but is again in evidence from 1924 on, the Class I roads as a whole reaching a continuous low point in 1928, the individual roads reaching this low point at various years from 1926 to 1928. We felt that we were justified in taking the years on any given road at their low point which

varies from 1926 to 1930 inclusive. The 1930 figures are doubtful, due to the effect of the depression.

A further analysis indicates that there was very little change in wages and cost of material during this period. We have analyzed the cost of repairs of numerous roads taking from 2 to 5 years of the period mentioned. With the complete inventory of the road we, of course, had locomotives of varying ages from one to fifty years old. Our analysis consisted of separating the cost of repairs by years of age, using the Horse Power Unit as the measuring stick. The results of our studies are rather astonishing in that they indicate generally that on any given road all locomotives of the same age have the same cost of repairs per Horse Power Unit irrespective of the size or service of the machine. Stated another way, having obtained the cost trend of a road, we can predict the cost of repairs per mile of a given locomotive for any number of years in the future.

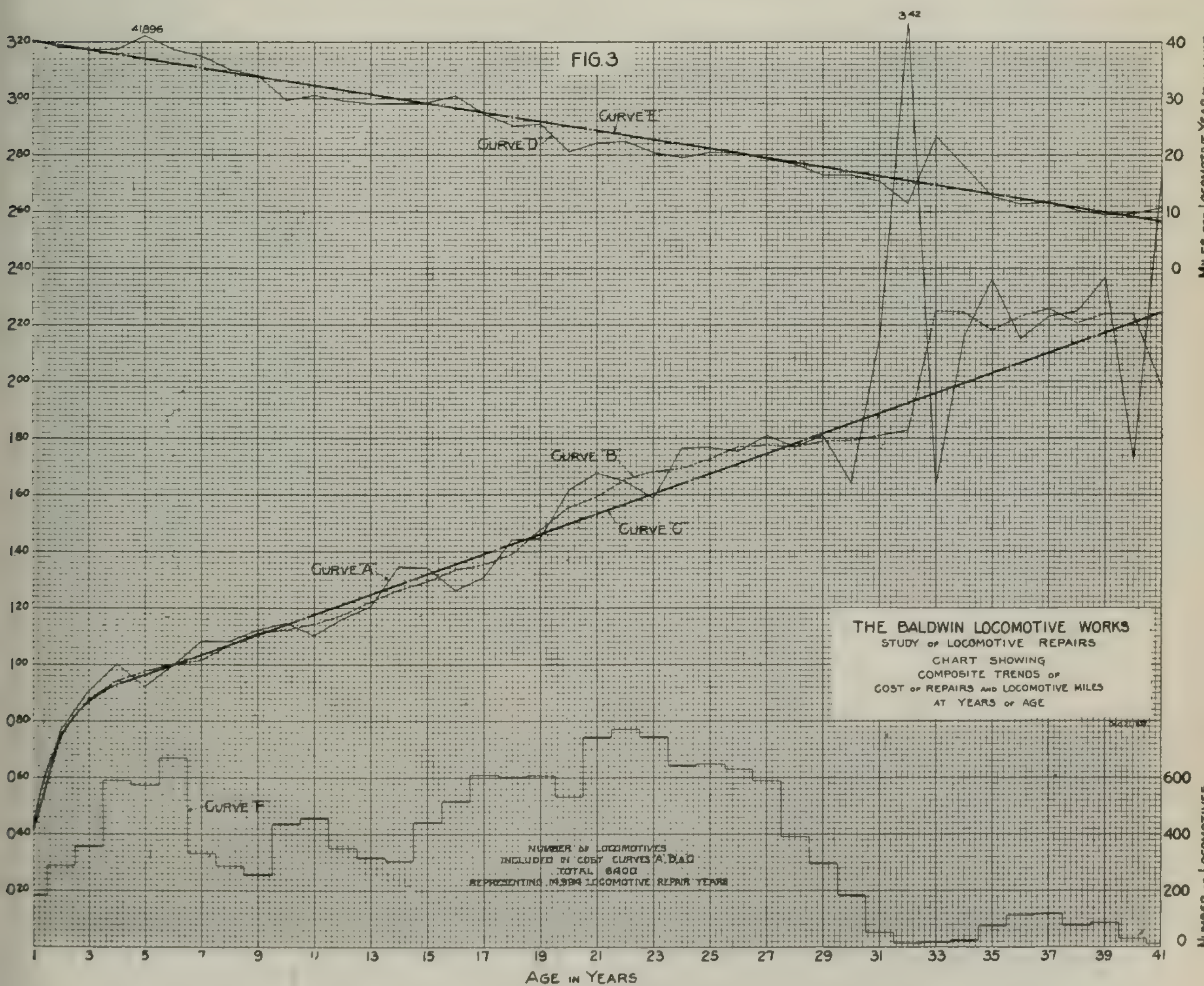

Figure 3

At this point I will give some examples of the results of our studies.

Figure No. 3 shows the average cost of the maintenance of locomotives that we have studied on trunk line railroads (trunk lines as distinguished from switching roads).

Curve "A" shows the actual figures as given to us by the railroad and the average cost per horse power unit of all the locomotives considered at the various years of age.

Curve "B" is a five year moving total of the actual cost shown in Curve "A". The five year moving total was used in order to smooth out inequalities in Curve "A".

Curve "C" is the trend determined from Curve "B" mathematically.

You will note that in this cost trend, made up of the actual figures from 6,400 different locomotives covering 14,994 locomotive years, that the actual results, Curve "A", form a definite trend and that the calculations producing Curve "B" and the final straight line, Curve "C", have not in any way modified this trend. In other words, Curve "C" represents the average cost of 6,400 locomotives at different years of age. The upper line on this chart shows the miles run per year at different years of age, and again you will note that the actual figures, Curve "D", practically determined the trend of the straight line "E". The straight line "E" is obtained by mathematical calculations from the points, Curve "D". The lower curve "F" shows the number of locomotives appearing in each year. You will note that the maximum locomotives are in the twenty-second year, numbering 773, i. e. the point of the twenty-second year on Curve "A" is the actual cost of repairs of 773 locomotives divided by the Horse Power Unit performance of these locomotives. Roughly, from the first to the twenty-seventh year the record covers an average of 500 locomotives in each year.

It will be noted that the choice of 10,000 potential horse power miles as a Horse Power Unit brings the cost per Horse Power Unit around $1.00.

Now the cost per Horse Power Unit consists of the cost of repairs measured by the Horse Power Unit and the Horse Power Unit is in effect a measure of capacity locomotive miles. This trend cost per Horse Power Unit can, therefore, be tabulated as the cost per locomotive mile for any given capacity of locomotive. The method is simple. You merely multiply the cost per Horse Power Unit by the potential horse power of the locomotive in question and divide by 10,000.

To illustrate, Figure 4 shows the cost per mile of locomotives of various capacities or potential horse powers. In other words, the trend cost curve of a road, based on Horse Power Units, is simply a method of drawing the cost per mile of various size locomotives at various years of age with one line in place of a multiplicity of lines as would be the case if each different size were plotted.

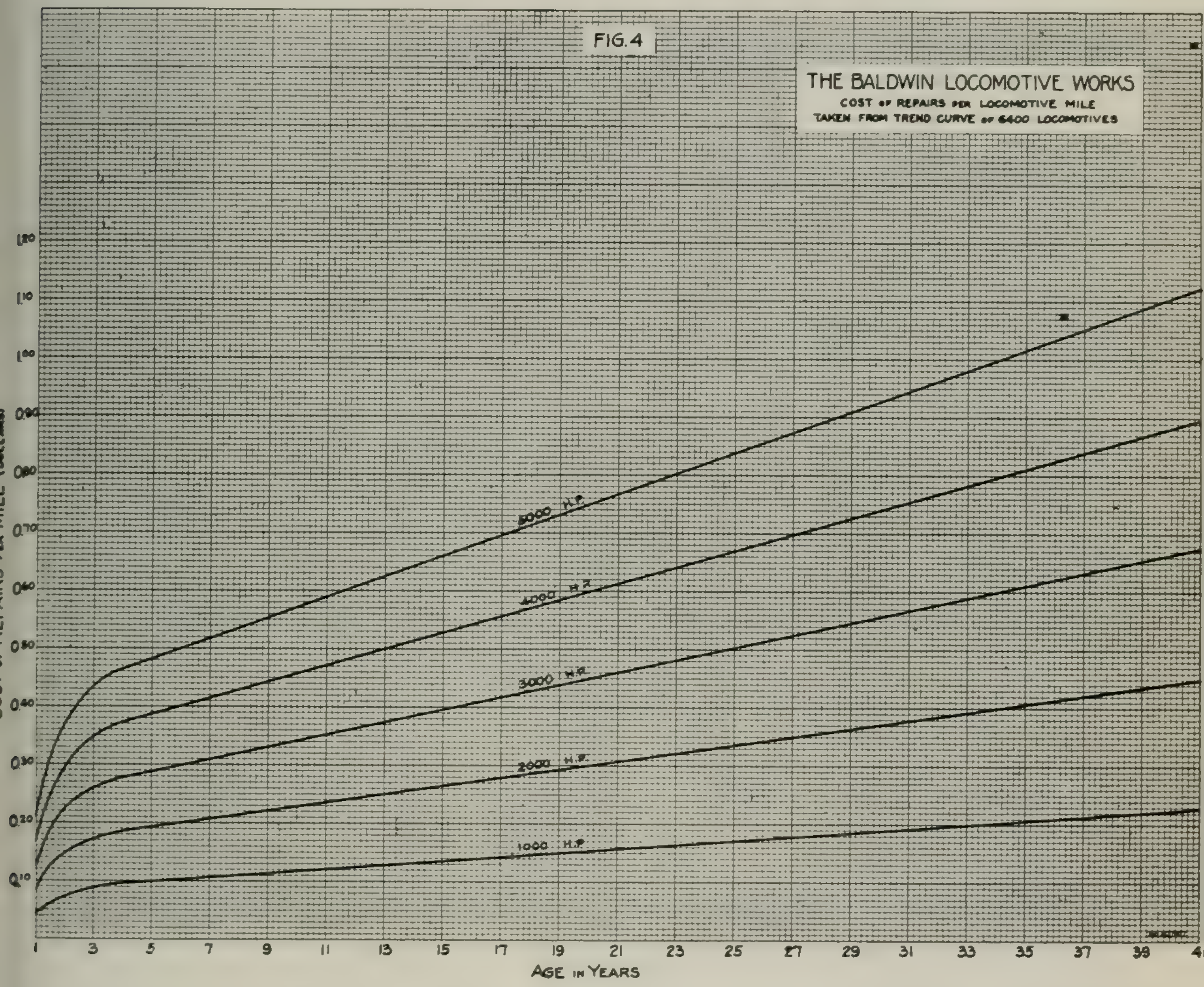

Figure 4

In our discussion with various roads the question has been raised to the effect that the increase in cost with age might be due to the constant advance in the art. This is undoubtedly true to some extent and if the trends are taken ten years from now, they will undoubtedly be lower at all ages. However, our studies indicate that the trend line of a road gives a correct value of the advancing maintenance cost of the present inventory with increasing age and that the cost of repairs of loco-

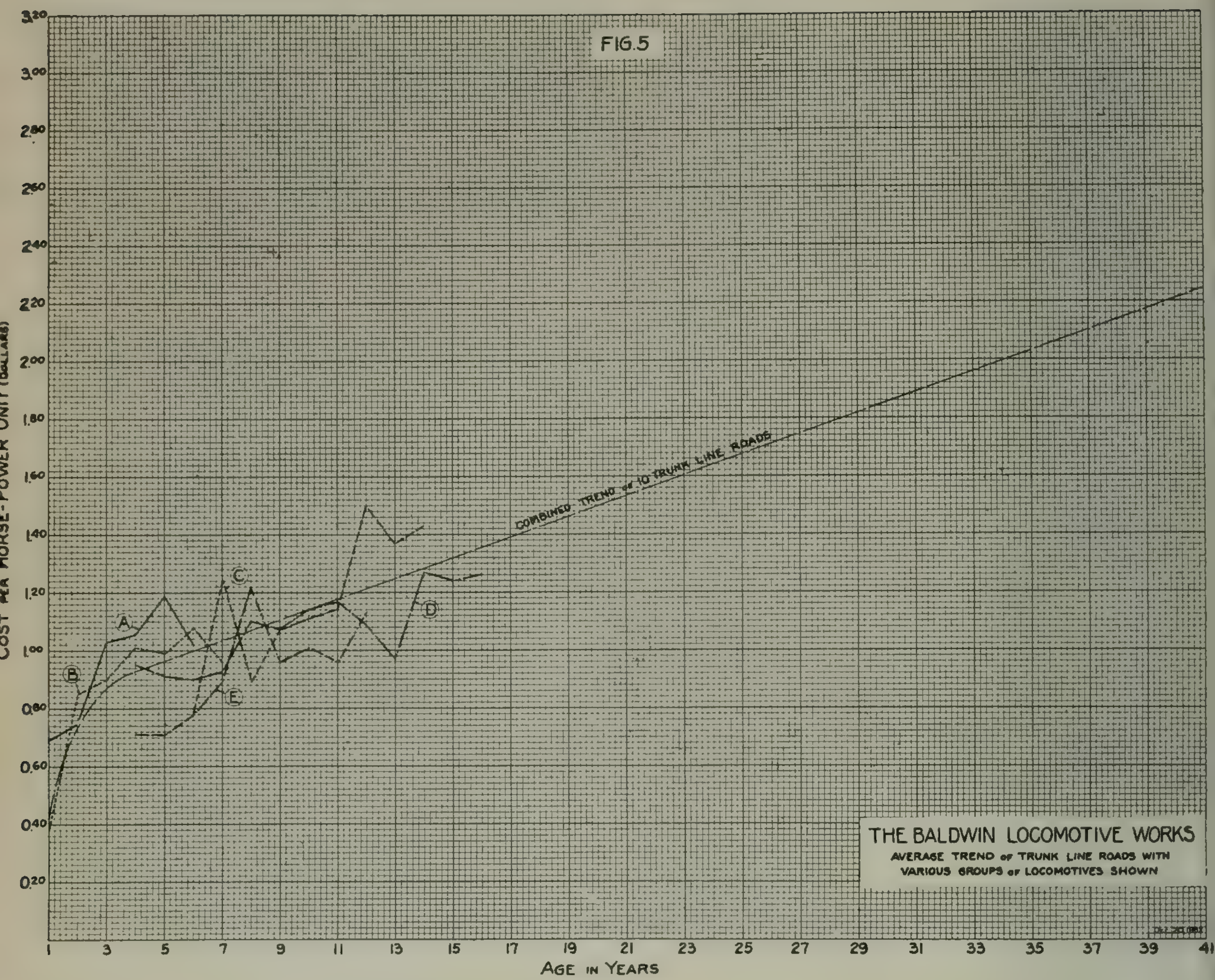

Figure 5

motives of the same class bought in different years, lies on this cost trend.

Figure No. 5 again shows the average trend of a number of trunk lines and on it we have plotted the trend of the large groups of locomotives studied, the groups consisting of the following:

Group	No. of Locomotives	Range in Years	P. H. P.
A	20	From 1 to 6 Years	4,505
B	44	" 1 " 7 "	3,409
C	47	" 6 " 14 "	3,241
D	310	" 4 " 16 "	2,440
E	148	" 4 " 12 "	2,620

It will be noted that although the locomotives are from

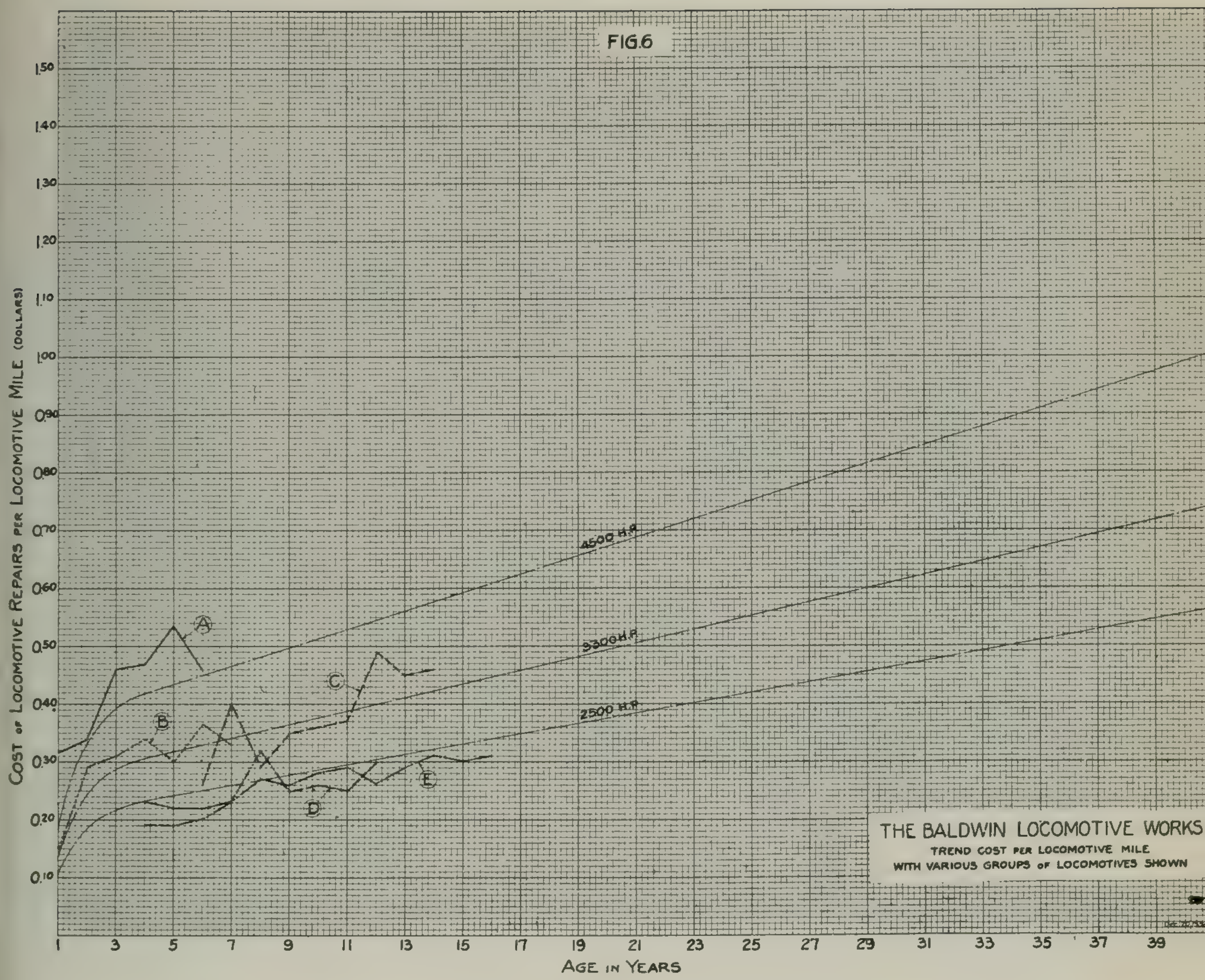

Figure 6

different roads, they fall fairly closely on the average trend curve of the trunk lines studied.

To again illustrate the conversion of the cost per Horse Power Unit into cost per mile, Figure 6 has been prepared.

On this chart we have plotted the cost per mile based on the average trend line of locomotives of 2500, 3300 and 4500 horse power and have converted the actual cost per Horse Power Unit of the groups of locomotives shown into cost per mile curves. You will note that Group "A" closely follows the cost of the 4500 horse power line; Groups "B" and "C" the 3300 horse power trend and Groups "D" and "E" the 2500 horse power trend.

We do not believe the average trend line of a number of roads can be used on any one property. The only trend worth while is the trend determined from the costs of the road in question. In other words, each road has its own trend line

determined by its shop conditions, its inventory and the physical aspects of the road.

Figure 7 shows the trend cost lines of a number of trunk lines. You will note that although they differ in value, they all have the same characteristics, a rapid increase in cost for

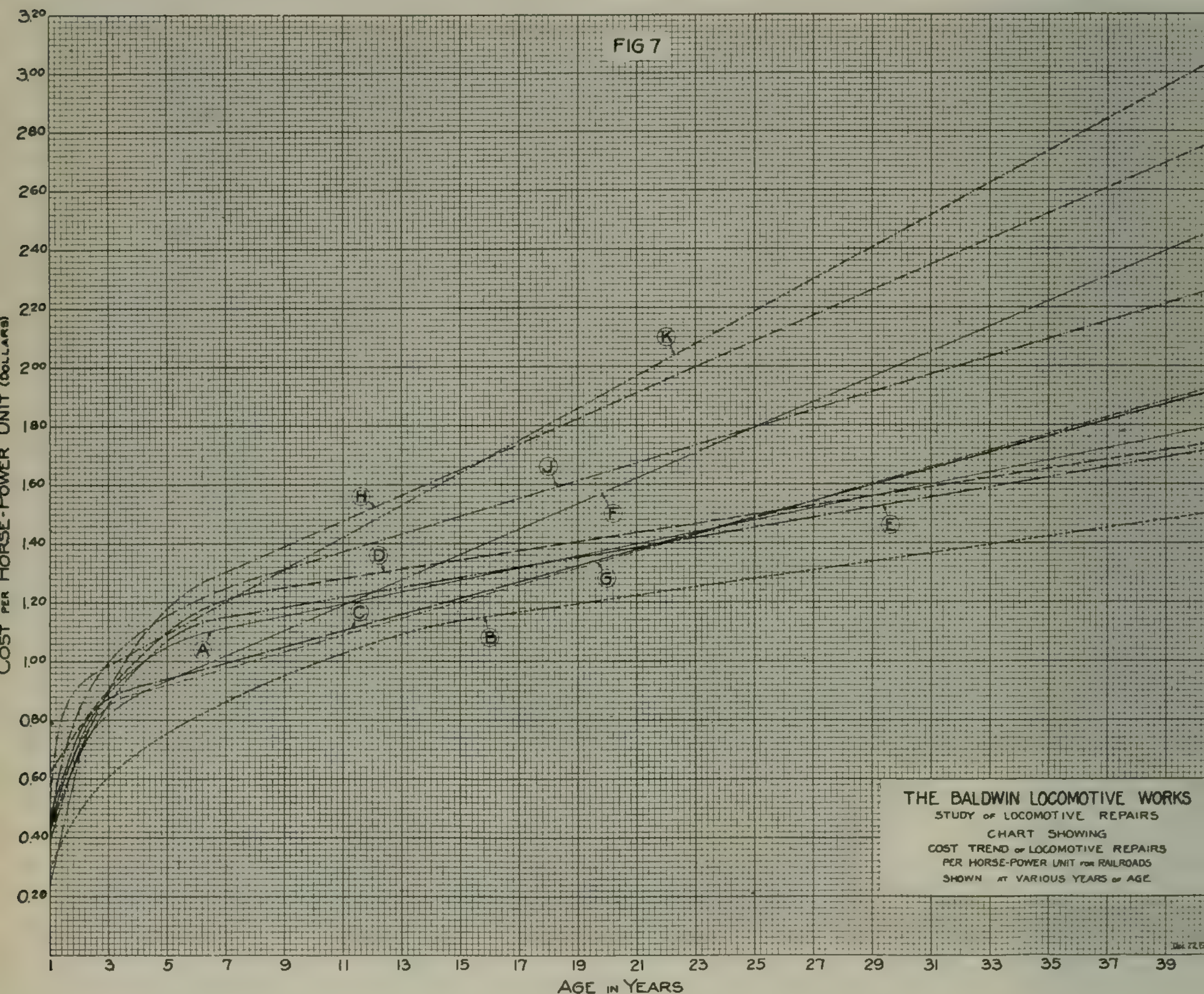

Figure 7

the first four years and then a constant increasing cost throughout their life.

The trend line of repair costs furnishes an excellent measure of the yearly maintenance efficiency, a problem of management, and when the costs are under control, it forms a means of anticipating future repair costs.

Figures 8 and 9 show two roads with entirely different conditions.

The road, illustrated on Figure 8, indicates high costs in

1927, costs fairly close to trend costs in 1928, 1929 and 1930, with high costs in 1931.

Figure 9 shows a road on which a radical change is taking place, with a decided increase in efficiency of maintenance. There may, of course, be deferred maintenance in the years

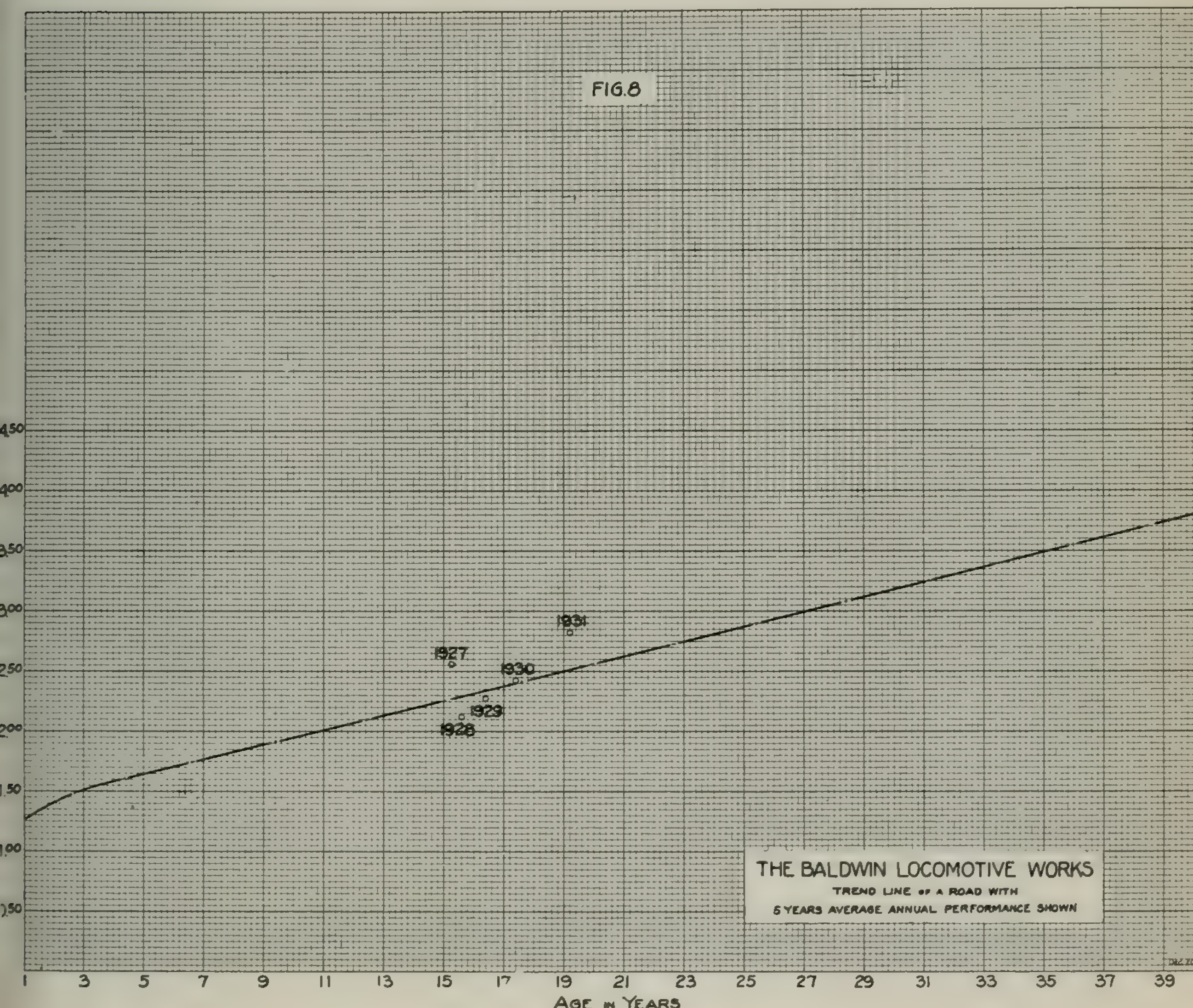

Figure 8

1930 and 1931, but the trend line which was made up from the four years shown, may be a fair trend of maintenance costs. It should, however, be used with caution due to the rapidly changing conditions.

Figure 10 shows a record with repair costs under good control. The cost records of this particular road show in all respects a well determined trend, and the trend can be confidently used for future costs.

The spotting of a year's performance on a trend line consists of two calculations—The cost per Horse Power Unit is the total cost of repairs divided by the Horse Power Unit performance. The age of use is obtained by dividing the sum of the products of Horse Power Units by each year of age by the total Horse Power Units.

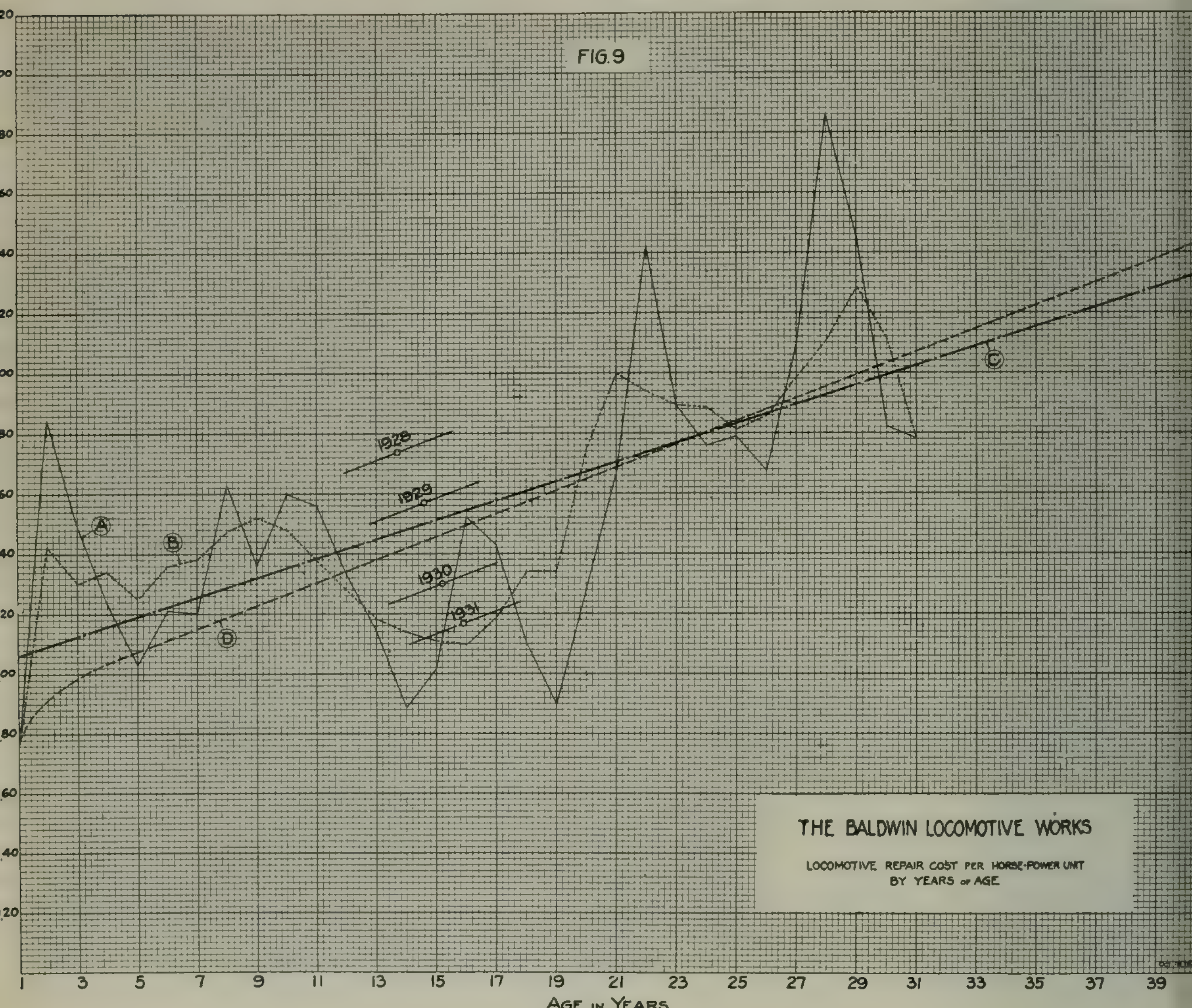

Figure 9

In our discussion of repair costs so far we have referred to trunk line roads. The term has been used advisedly as we have found that the costs on so-called switching lines are considerably higher than on the larger roads. This is due to the following reasons:

Less volume of work for necessary total shop equipment.

Short engine runs.

Figure 11 shows a number of switch road trend lines. You will note that these trends or cost curves do not have any great divergence from each other and a combined curve would be representative of this type of road. We show such a combined curve in Figure 12.

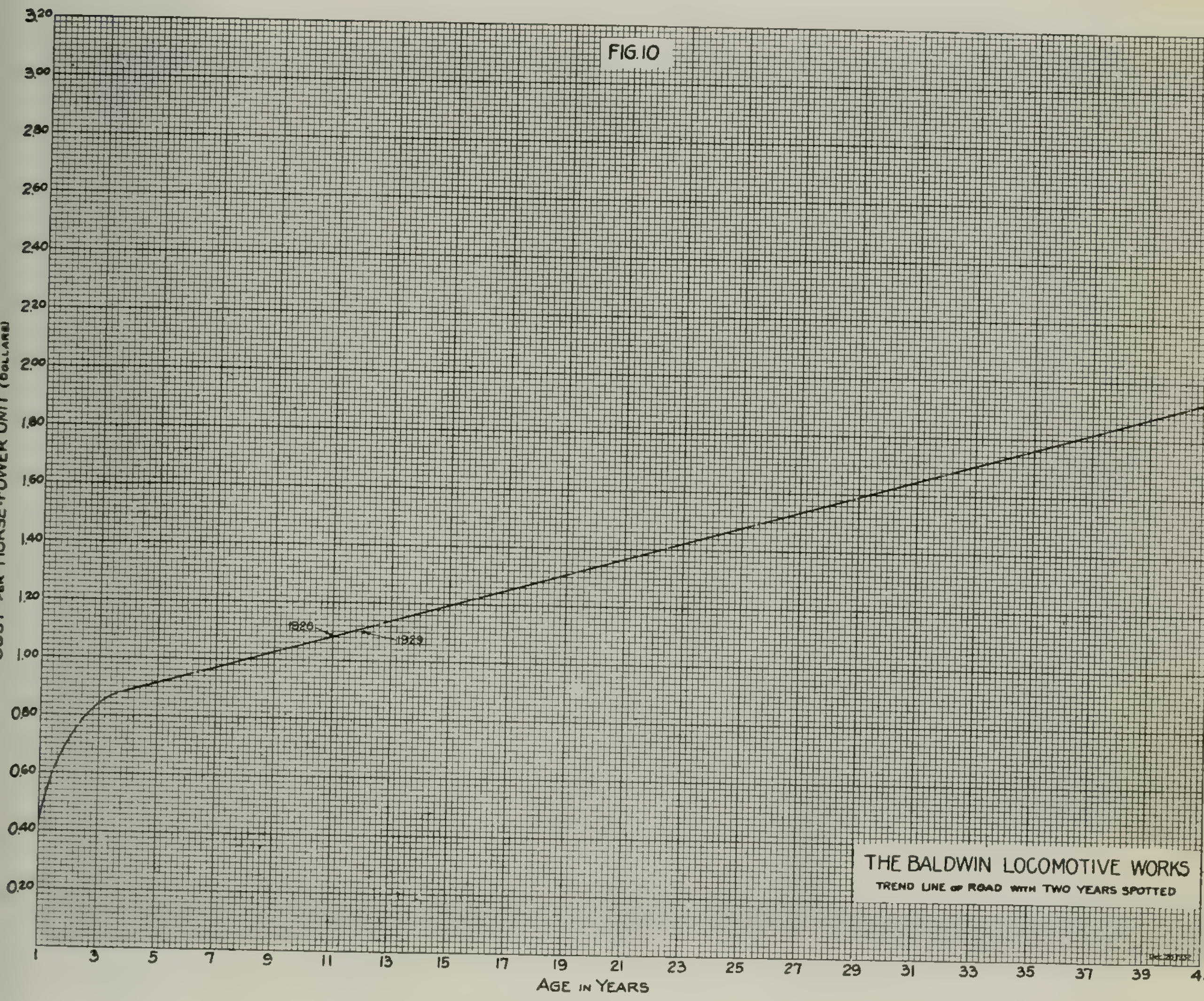

Figure 10

As brought out before, a trend cost per Horse Power Unit can be translated into cost per mile and the cost per mile can be converted into cost per hour, assuming six miles per hour.

Figure 13 shows the cost trend per hour of various sizes of locomotives, based on the combined trend curve of the switching lines shown in Figure 12.

I have given considerable time to the trend of cost of maintenance as it is one of the most important factors in the study of locomotive economies. Locomotive maintenance is the great-

est variable factor in the list of items affecting operating costs and to determine the exact economy in the substitution of new power, it is necessary to be able to project the cost of repairs of both the old and new power into the future.

The calculations of repair costs on an existing trend line are conservative as there is no doubt that the new locomotives

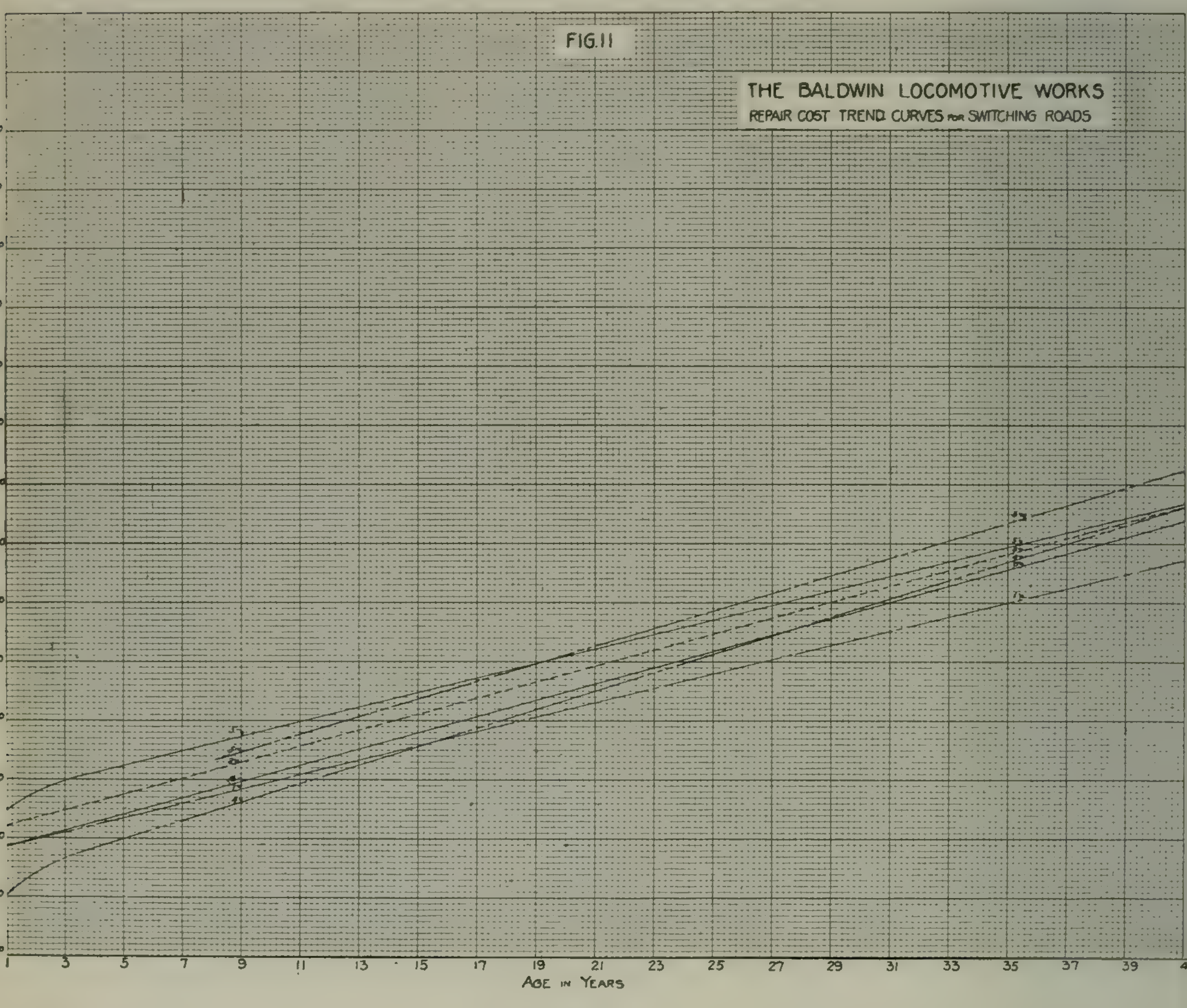

Figure 11

will have a repair cost less than the trend, due to improved design and material. Therefore, savings in repairs of new over old locomotives will be understated to the extent that the maintenance costs of the new locomotives fall under the trend cost made by the older power.

SELECTION OF POWER.

In general the selection of power should be that which will make the greatest return to the property for each dollar of

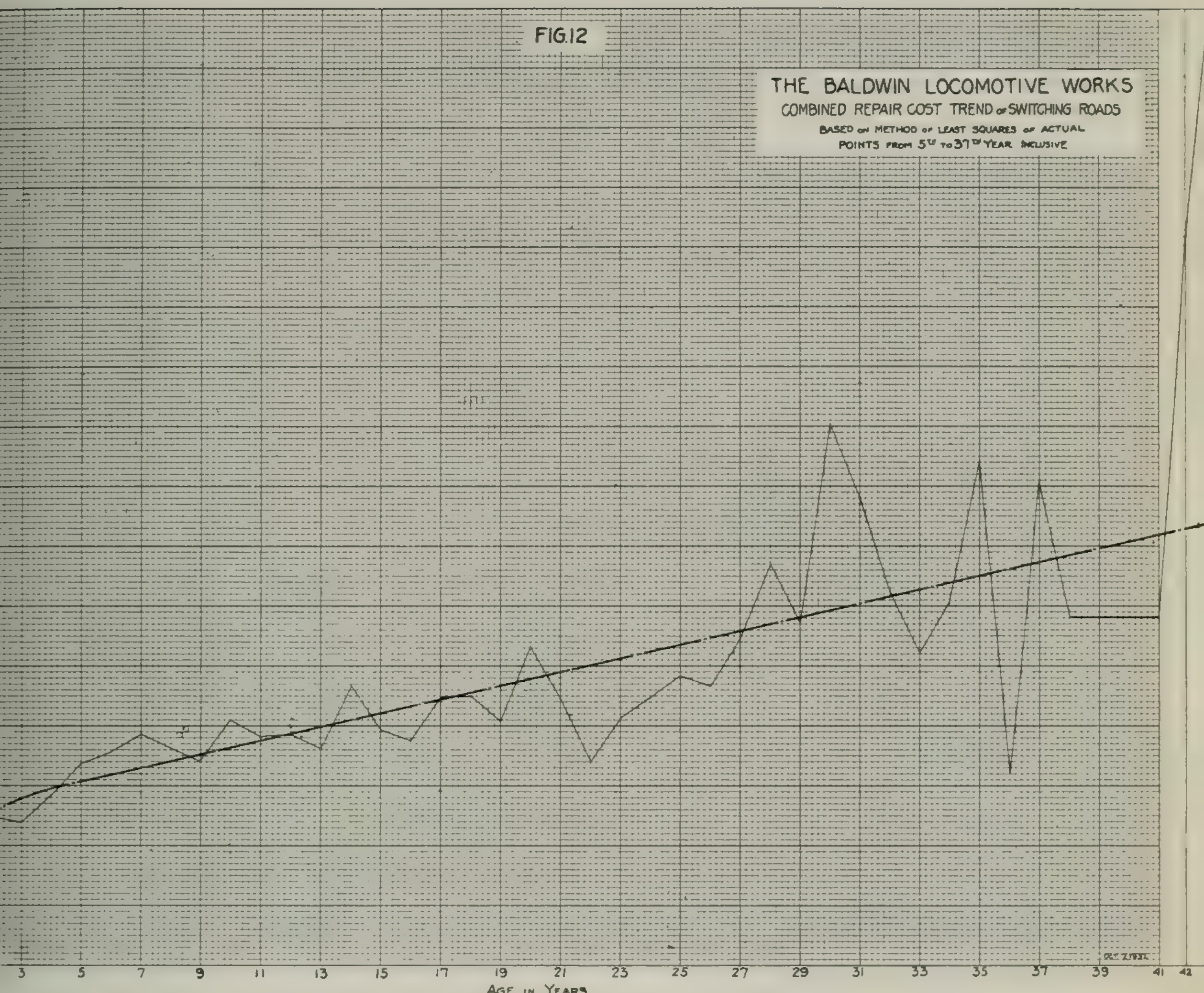

Figure 12

expenditure, all factors taken into consideration. Increased speed of a given service, due to smaller trains or larger locomotives, adversely affects the direct economy of any substitution. It is possible in given cases that the cost of increase in speed *per se* may more than offset the favorable factors, resulting in an actual increase in direct operating expense. But in these cases the management must give careful consideration to the fact that the increase in speed of operation reduces the amount of locomotive and car equipment required for the traffic. The above point, together with the commercial advantage of greater traffic received by virtue of increased speed, must be balanced against its cost.

Each case of possible substitutions of modern power is an example in itself and requires detailed study and we cannot lay down rules that will cover all of them without modification.

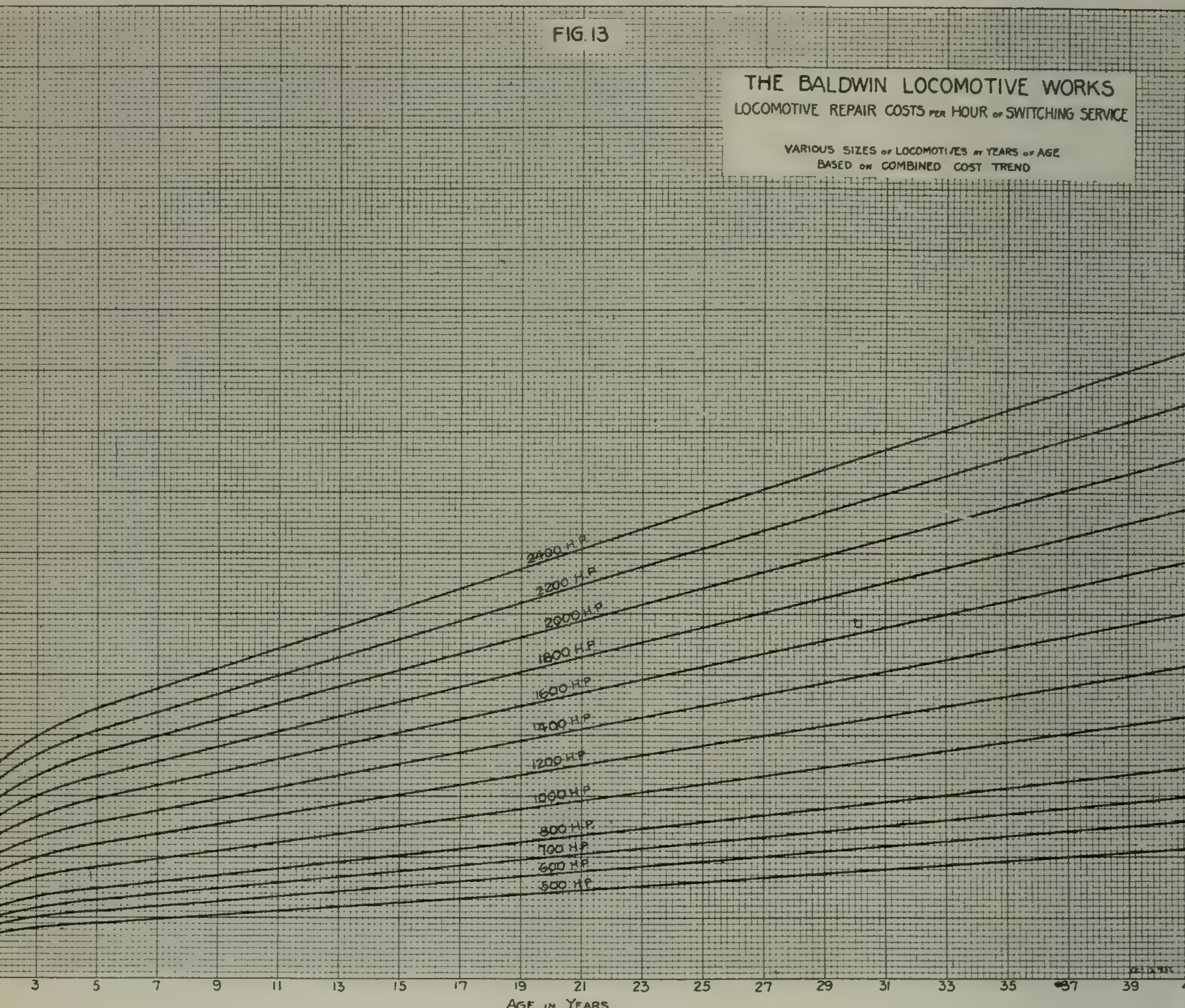

Figure 13

We have, however, done considerable work for the past two years in calculations of economies in locomotive performance, which have led us into various methods, and we have chosen those methods which allow of the quickest solution, keeping in mind the accuracy required.

We believe that the results of our work as to method will be interesting and of some value to you at this time, principally from the fact that the railroads are going into a chapter of detailed economy and all expenditures and all operations must be viewed with their effect on the operating income. We will not endeavor to analyze a complete problem, but will cover various aspects of detailed problems that will disclose the methods that we have chosen.

One of the more common problems is determining the economy in the application of larger freight locomotives on a given division or engine run. We believe that loading of the new

locomotives should bear the same relationship to their capacity as the present loading bears to the present locomotives, and that the coal and water consumption should be determined by using the performance of the present locomotives as a basis. As a preliminary step in this case we have resorted to the pull-speed curve. The pull-speed curve shows the train load in given weight of car that can be hauled by various locomotives at various speeds on a given grade. A method of making up pull-speed curves is covered in detail in an article in the July, 1932,

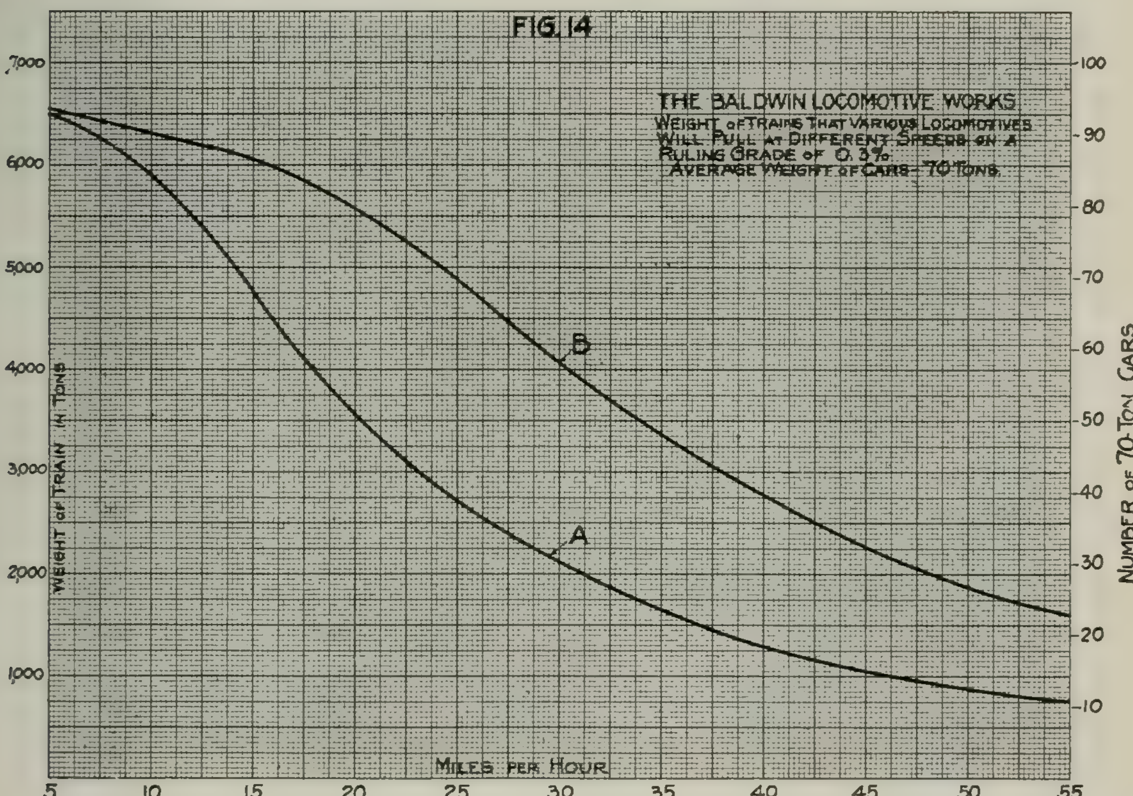

Figure 14

Baldwin Locomotives entitled "The Effect of Boiler Capacity on Revenue."

In a normal case we make up a pull-speed curve of the present locomotives and various locomotives contemplated on the ruling grade in each direction of the run in question. We then determine which direction controls, and use this pull-speed curve in determining the loading of our engines. Such a curve is shown in Figure 14.

We find that the present locomotive "A" can handle its average train of 2,660 tons over the controlling grade at 25 M. P.H. In order to load the proposed locomotives in the same

relationship to the present, follow the 25 M.P.H. line up to its intersection with Curve "B" of the new locomotives and we find a tonnage of 4,820 tons.

We then prepare the tabulation shown in Figure 15, and from the actual performance of the present locomotives, we determine the performance of the new locomotives.

Performance Based on Month of........................19....

Speed Over Ruling Grade 25 M.P.H.—Controlling Grade Northbound

Item	No.	Present Locomotive	Proposed Locomotive
Number of round trips	1	**190**	104
Number of enginehouse movements	2	**380**	208
Sq. ft. of grate area	3	**94.9**	**88.0**
Lbs. of coal per terminal movement at 30 lbs. per sq. ft. of grate area	4	2,849	2,640
Total lbs of coal used	5	11,540,220	10,982,400
Total terminal coal	6	1,082,620	549,120
Coal used on road	7	10,457,600	10,433,280
Total time on road	8	**3,800**	**2,080**
Coal per hour on road	9	2,752	5,016
Coal per sq. ft. of grate area	10	29	57
Lbs. of water per sq. ft. of grate area	11	232	420
Lbs. of water per hour	12	22,054	36,954
Steam factor	13	**19.5**	**18.0**
Average horse power on road	14	1,129	2,053
Potential horse power	15	**2,232**	**4,191**
Ratio horse power used and potential horse power	16	50.6	49.0
Average train tons—north	17	2,660	4,861
Average train tons—south	18	**2,128**	3,889
Double weight of locomotive—Tons	19	**472**	**774**
Total weight both directions	20	5,260	9,524
Average weight of trains	21	2,630	4,762
Tons average train per horse power	22	2.32	**2.32**
Total tons carried north	23	**505,400**	**505,400**
Total tons carried south	24	**404,320**	**404,320**
Locomotive miles per month	25	**114,000**	62,400
Coal per locomotive mile	26	**101.2**	176.1
Average speed round trip	27	**30 M.P.H.**	**30 M.P.H.**
Length of division	28	**300 Mi.**	**300 Mi.**
Horse power units required	29	25,444	26,152

Figure 15

In the column headed "Present Locomotive" the figures in heavy type are obtained from the records of the road; the other items are calculated.

Item 4, terminal coal, is the grate area multiplied by 30, it

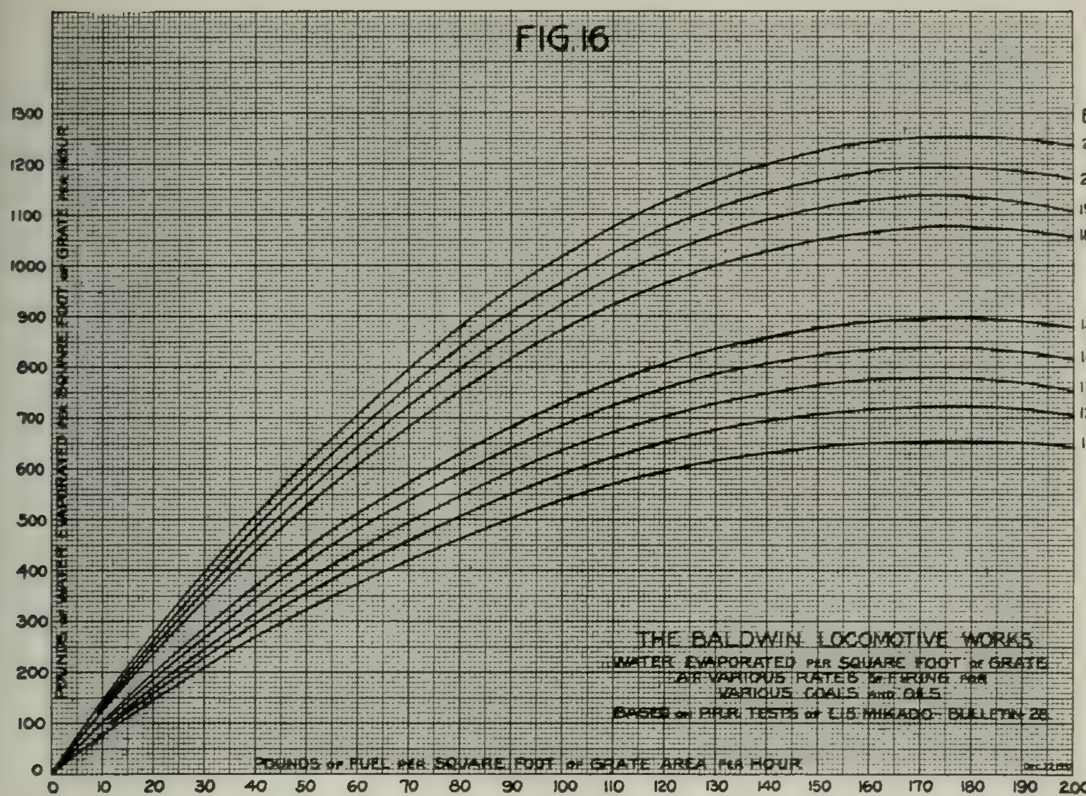

Figure 16

being assumed that the average terminal loss amounts to 30 pounds of coal per square foot of grate area.

Item 5, total coal used, is the locomotive miles, item 25, multiplied by the coal per engine mile, item 26.

Item 6, total terminal coal, is the coal lost per terminal or enginehouse movement, item 4, multiplied by the number of enginehouse movements, item 2.

Item 7, coal used on road, is the total coal, item 5, less the terminal coal, item 6.

The terminal coal is often of considerable amount. In the example shown it is over 500 tons per month.

Item 9, coal used per hour on road, is the coal used on road, item 7, divided by the hours on road, item 8.

Item 10, coal burned per sq. ft. of grate area per hour, is the coal per hour, item 9, divided by the sq. ft. of grate area, item 3.

Item 11, water evaporated per sq. ft. of grate area per hour, is obtained from item 10 by reference to a set of curves based on the comparative value of coal burned at various rates, Figure 16. The pounds of water per pound of coal at various rates

of firing were taken from the results obtained on the Altoona Test Plant of the Pennsylvania Railroad.

In this particular example we have assumed coal of 13,000 B.T.U. Locating the vertical line representing 29 pounds of coal burnt per square foot of grate area, we follow this up until it meets the 13,000 B.T.U. curve and we find that the rate is equivalent to an evaporation of 232 pounds of water per square foot of grate area per hour.

Item 12, water used per hour, is the water per square foot of grate area multiplied by the square feet of grate area, item 3.

Item 14, average horse power on road, is the average water evaporation per hour divided by the steam factor of the locomotive, item 13.

Item 16, ratio average horse power to capacity horse power, is obtained by dividing the average horse power, item 14, by the calculated potential horse power of the locomotive, item 15.

In this example the ratio is 50.6 and it is of interest to know that in our work we find on a normal engine run that this ratio varies from about 45 to 54. However, on divisions where there is a constant heavy pull, this ratio may be as high as 70 to 80.

Item 20, total weight of train, both directions, is the sum of items 17, 18 and 19; and item 21 is one-half of item 20 and is the average train handled including the engine and tender.

Item 22, tons average train per horse power, is item 21 divided by item 14.

This item can be considered as the index of the engine run and is used in determining the performance of the proposed locomotive.

Now referring to the column covering the proposed locomotive, the figures underlined are either obtained from the specification of the proposed locomotive or transferred from the column of the present locomotive; the other items are calculated. The first step is to obtain the weight and number of trains. The weight of train is roughly obtained for the controlling grade, item 17, from the pull-speed curve, Figure 14. The rough figure is divided into the total tons handled north, item 23, and the even number of trains thus obtained is divided into item 23 to obtain the exact figure for item 17.

Item 18, average train tons—south—is then obtained by dividing item 24 by item 1.

Item 20, total weight of train, both directions, is the sum of items 17, 18 and 19; and item 21, the average weight of train, is one-half of item 20.

We can now obtain the average horse power, item 14, by dividing the average weight of train, item 21, by the Division index, item 22.

Item 16, the ratio of the horse power used, can then be obtained by dividing item 14 by item 15. In this particular case you will notice that the ratio is 49 as compared with 50.6 for the present power, which means that the new locomotive has a trifle more horse power than required to maintain the same speed at all points on the Division as the present power. If this ratio was larger than that of the present locomotive, it would be necessary, in order to maintain proper speeds, to revise the calculations by either the substitution of a locomotive of greater horse power or decreasing the proposed train load.

Item 12, water per hour, is now obtainable by multiplying the average horse power, item 14, by the steam factor, item 13.

Item 11, pounds of water per square foot of grate area, is item 12 divided by the fire-box grate area, item 3.

Item 10, coal per square foot of grate area, can now be obtained from item 11 by reference to the coal and water curve that was shown in Figure 16.

Item 9, coal per hour on road, is item 10 multiplied by the square feet of grate area.

Item 8, total time on road, is the number of trips multiplied by 20 hours, which is the average time per round trip.

Item 7, total coal used on road, is the coal per hour, item 9, multiplied by the hours on road, item 8.

Item 6, total terminal coal, is the coal per terminal movement, item 4, multiplied by the number of terminal movements, item 2.

Item 5, total coal used, is the sum of items 6 and 7.

We have not before referred to item 29, the horse power units required. In each case the horse power units required is, of course, the potential horse power, item 15, multiplied by the locomotive miles, item 25, divided by 10,000. The comparison of item 29 under the captions "Present" and "Proposed Locomotives" is another check on our calculations. In the particular instance you will note that the proposed locomotive produced slightly more horse power units than the present, indicating again that the locomotive is entirely satisfactory for the work intended. If the horse power units under the proposed locomotive were less, there would be some doubt as to the ability of the locomotive to perform the service. If the horse power units for the proposed locomotive were considerably greater than

the present locomotive, it would indicate that we were substituting a locomotive of greater capacity then required for the work.

We feel that the above method, which you will note is fundamentally based on the potential horse power calculations, is a comparative method of determining the type of locomotive required for a given service and although the intermediate steps may not be absolutely correct, they are comparative and a new locomotive calculated this way will satisfactorily perform the service. It will allow of the same variation above and below the average train as does the present locomotive. It will operate at the same speed over the different portions of the Division and it will be operated at practically the same load factor at all points on the Division. In the above I stated that the intermediate steps might not be exact. For instance, the average horse power is shown for each locomotive. This horse power will probably not check with the average indicated horse power as obtained by the dynamometer car. However, it is relative and will have the same relationship to the actual horse power on both the present and the proposed locomotives.

We believe that the above is a very simple method of determining a locomotive that should be purchased for a given service. By putting in the figures under the column "Present Locomotive" obtained from the present service, you can then work up any proposed locomotive, either for an increase in train load as covered in the example shown, or for an increase in speed either with the present load or increased load. The method ties up the proposed performance with the actual division conditions, automatically takes into consideration the transportation requirements and the physical aspects of the particular line.

Having worked out the calculations it is quite evident that it is a very simple matter to price the various items entering into the operating expense of the present and proposed locomotives. The direct costs consist of seven items:

1. **Locomotive Repairs.** This cost is based on the cost per horse power unit at the age of the locomotive that it is proposed to replace obtained from the trend line of the road. The cost of repairs of the new locomotive, of course, would be the horse power units required multiplied by the horse power unit cost for the first year, as obtained from the trend.

2 **Crews' Wages.** This item, insofar as the present locomotive is concerned, is a matter of record. With the new loco-

motive it would be a function of the number of round trips and the additional wages that it might be necessary to pay the engine crews on account of the increased weight of the locomotive.

3. **Fuel.** The fuel cost is calculated from the example just given.

4. **Enginehouse Cost.** This, of course, is the number of enginehouse movements multiplied by the average cost. In the case of the proposed locomotive we recommend that the enginehouse cost, lubrication and other supplies be increased by a percentage of half the percent of increase in weight of the new over the old locomotive.

5. **Lubrication.** This, of course, is the engine miles multiplied by the cost per mile. In the case of the proposed locomotive this cost should be corrected as shown above.

6. **Water.** This is directly obtainable in the example above given.

7. **Locomotive, Other Supplies.** This is the miles run times the cost per engine mile, the cost for proposed locomotive being increased as shown above.

The economy in capital investment in motive power on the one hand and its effect on the operating expense of the Road on the other are both items that need careful consideration in their presentation. The factor of variable savings in locomotive repairs is seldom given weight in these considerations. To illustrate, let us take a problem (similar to an actual case) where three locomotives, costing $120,000 each, are purchased from cash reserves to take the place of locomotives eighteen years old. The new locomotives are to handle the same trains at the same speed, but are of such larger proportions that they do away

	Present Power	Proposed Power	Savings
Locomotive repairs	$119,604	$35,559	$84,045
Crews' wages	77,936	70,336	7,600
Fuel	105,600	89,600	16,000
Enginehouse cost	7,740	5,400	2,340
Lubrication	1,320	1,120	200
Other supplies	1,056	896	160
Water	1,171	1,075	96
Total operating expense	$314,427	$203,986	$110,441
Annual savings less repair savings			$26,396

Figure 17

with a certain amount of helper mileage. We will also assume that the replaced locomotives are set back (making secondary economies that we will not take into consideration) and replace locomotives of the same original value as that of the new power; that the locomotives, replaced by the second move, are retired and that their depreciation, plus scrap value, allows of taking them out of the inventory without any charge to operating expense or surplus.

Year	Repairs Old Locomotives Rate	Repairs Old Locomotives 87,622 H.P.U.	Repairs New Locomotives Rate	Repairs New Locomotives 90,944 H.P.U.	Repair Saving	Total Saving Repair Saving Plus Constant $26,396
1	1.365	$119,604	.391	$35,559	$84,045	$110,441
2	1.401	122,758	.685	62,297	60,461	86,857
3	1.437	125,913	.802	72,937	52,976	79,372
4	1.473	129,067	.861	78,303	50,764	77,160
5	1.509	132,222	.897	81,577	50,645	77,041
6	1.545	135,376	.933	85,760	49, 616	76,012
7	1.581	138,530	.969	89,034	49,496	75,892
8	1.617	141,685	1.005	92,308	49,377	75,773
9	1.653	144,839	1.041	95,582	49,257	75,653
10	1.689	147,994	1.077	98,856	49,138	75,534
11	1.725	151,148	1.113	102,130	49,018	75,414
12	1.761	154,302	1.149	105,404	48,898	75,294
13	1.797	157,457	1.185	108,678	48,779	75,175
14	1.833	160,611	1.221	111,952	48,659	75,055
15	1.869	163,766	1.257	115,226	48,540	74,936
16	1.905	166,920	1.293	118,500	48,420	74,816
17	1.941	170,074	1.329	121,774	48,300	74,696
18	1.977	173,229	1.365	125,048	48,181	74,577
19	2.013	176,383	1.401	128,322	48,061	74,457
20	2.049	179,537	1.437	131,596	47,941	74,337
21	2.085	182,692	1.473	134,870	47,822	74,218
				Total		$1,632,710
				Average per Year		$77,748

Figure 18

The comparative annual cost of operation of the new power with the old power is shown in Figure 17.

The annual savings less repairs in this statement, amounting to $26,396, are the transportation savings and can be considered constant. The savings in repairs vary from year to year and must be treated on that basis.

The tabulation, shown above, Figure 18, shows the cost of repairs of the old and new power for each year of the invest-

ment, the repair savings and the total savings. The total savings are the repair savings plus the transportation or constant savings. The cost of repairs in Figure 18 is based on the average costs of 4082 locomotives.

It will be noted in Figure 18 that the average annual saving over a twenty-one year period is $77,748.

INVESTMENT $360,000

Average annual savings		$77,748
Carrying charge—		
Interest 5%	$18,000	
Depreciation 4½%	16,200	
Taxes and insurance 1½%	5,400	
Total		39,600
Net savings		$38,148

Net sav'ngs amount to 10 6% on the investment after carrying charge. The actual return on the investment is 15.6%.

Figure 19

It is customary to set up the economy of the investment as shown in statement, Figure 19.

The above statement does not present the facts of the case. As there is no offset to the depreciation, it is shown correctly, but a straight 5% interest charge on the original investment should not be made because the money represented by the annual depreciation decreases the investment in equal amount. A statement of this kind would more correctly reflect the facts if an average rate of interest of 2½% was used.

Relative to taxes and insurance, here again the depreciated value (the assessed value being in similar proportion) reduces

INVESTMENT $360,000

Average annual savings		$77,748
Carrying charge—		
Average interest 2½%	$9,000	
Depreciation 4½%	16,200	
Taxes and insurance	2,000	
Total		27,200
Net savings		$50,548

Net savings amount to 14.0% on the investment after carrying charge. The actual return on the investment is 16.5%.

Figure 20

both items and further there is a certain amount of credit that must be applied to these items by virtue of the retirement of the old power. For a statement of this kind something less than a mean rate of .75% should be taken. Let us assume a flat average adjusted charge in this case of $2,000 per year. We would then have a revised statement as shown in Figure 20:

Although the second statement is closer to the facts than the first statement, it does not, in our opinion, give a comprehensive picture. We believe the best method is to show the actual cash transaction, using the savings made by the new power to amortize its investment. Such a statement, covering the case under consideration, is shown in Figure 21.

Year of Investment.	Investment 3 Locos. @ $120,000	Annual Saving	Interest on Reduced Investment at 5%	Net Increase of Taxes and Insurance	Saving Less Interest, Taxes and Insurance	Reduced Capital	Betterment in Cash Position		
							Annual	Cumulative	Annual Compounded @ 5% for Period
1	$360,000	$110,441	$18,000	$3,400	$89,041	$270,959			
2		86,857	13,548	3,260	70,049	200,910			
3		79,372	10,046	3,120	66,206	134,704			
4		77,160	6,735	2,980	67,445	67,259			
5		77,041	3,363	2,840	70,838		$3,579	$3,579	$7,8
6		76,012		2,700	73,312		73,312	76,891	152,4
7		75,892		2,560	73,332		73,332	150,223	145,1
8		75,773		2,420	73,353		73,353	223,576	138,3
9		75,653		2,280	73,373		73,373	296,949	131,7
10		75,534		2,140	73,394		73,394	370,343	125,5
11		75,414		2,000	73,414		73,414	443,757	119,5
12		75,294		1,860	73,434		73,434	517,191	113,9
13		75,175		1,720	73,455		73,455	590,646	108,5
14		75,055		1,580	73,475		73,475	664,121	103,3
15		74,936		1,440	73,496		73,496	737,617	98,4
16		74,816		1,300	73,516		73,516	811,133	93,8
17		74,696		1,160	73,536		73,536	884,669	89,3
18		74,577		1,020	73,557		73,557	958,226	85,1
19		74,457		880	73,577		73,577	1,031,803	81,1
20		74,337		740	73,597		73,597	1,105,400	77,2
21		74,218		600	73,618		73,618	1,179,018	73,6
									$1,745,2
						Yearly Average			83,1
						Percent on investment			23

Figure 21

This statement shows from a cash consideration that the investment is in effect one that in addition to absorbing all of its resultant capital carrying charge, will net 23.1% on the invested capital on the basis of a twenty-one year life. This statement takes into consideration the varying cost of repairs, which is of considerable moment.

We have presented enough information in the case in hand to set up a tabulation showing the affect on the operating income and the resultant improvement in cash position. Such a statement is shown in Figure 22.

ar of est- ent	Investment Less Depreciation (Book Value)	Annual Saving	Interest on Investment @5%	Depreciation @ 4½%	Adjusted Taxes and Insurance	Balance to Income After Deductions	Improvement in Cash Position	
							Annual	Cumulative
	$360,000	$110,441	$18,000	$16,200	$3,400	$72,841	$89,041	$89,041
	343,800	86,857	17,190	16,200	3,260	50,207	66,407	155,448
	327,600	79,372	16,380	16,200	3,120	43,672	59,872	215,320
	311,400	77,160	15,570	16,200	2,980	42,410	58,610	273,930
	295,200	77,041	14,760	16,200	2,840	43,241	59,441	333,371
	279,000	76,012	13,950	16,200	2,700	43,162	59,362	392,733
	262,800	75,892	13,140	16,200	2,560	43,992	60,192	452,925
	246,600	75,773	12,330	16,200	2,420	44,823	61,023	513,948
	230,400	75,653	11,520	16,200	2,280	45,653	61,853	575,801
	214,200	75,534	10,710	16,200	2,140	46,484	62,684	638,485
	198,000	75,414	9,900	16,200	2,000	47,314	63,514	701,999
	181,800	75,294	9,090	16,200	1,860	48,144	64,344	766,343
	165,600	75,175	8,280	16,200	1,720	48,975	65,175	831,518
	149,400	75,055	7,470	16,200	1,580	49,805	66,005	897,523
	133,200	74,936	6,660	16,200	1,440	50,636	66,836	964,359
	177,000	74,816	5,850	16,200	1,300	51,466	67,666	1,032,025
	100,800	74,696	5,040	16,200	1,160	52,296	68,496	1,100,521
	84,600	74,577	4,230	16,200	1,020	53,127	69,327	1,169,848
	68,400	74,457	3,420	16,200	880	54,457	70,657	1,240,505
	52,200	74,337	2,610	16,200	740	54,787	70,987	1,311,492
	36,000	74,218	1,800	16,200	600	55,618	71,818	1,383,310

Figure 22

It will be noted that after deducting from savings the interest on the book value, depreciation, taxes and insurance, we still have a substantial amount transferable to income. The column headed "Balance to Income after Deductions" shows the improvement in the operating expense statement for each year

and you will note that this varies from a minimum of roughly \$42,000 to \$73,000. The improvement in cash position is well worth consideration. In this case it amounts to over \$1,300,000 at the end of twenty-one years' service of the three new locomotives, without crediting this \$1,300,000 with any interest.

We have discussed the savings to be obtained by substitution of new power and the justification of the required expenditure. There is an entirely different phase of this matter and that is the predetermination of the economic life of the new power when purchased. Taking the example that we have been discussing, from the facts that we have set up a determination can be made of the total cost of operation of this service for varying years of life of the new locomotives. As far as we know at this writing, this cannot be reduced to a formula due to the number of variables involved, but we have taken this particular case and worked out the average total cost of oper-

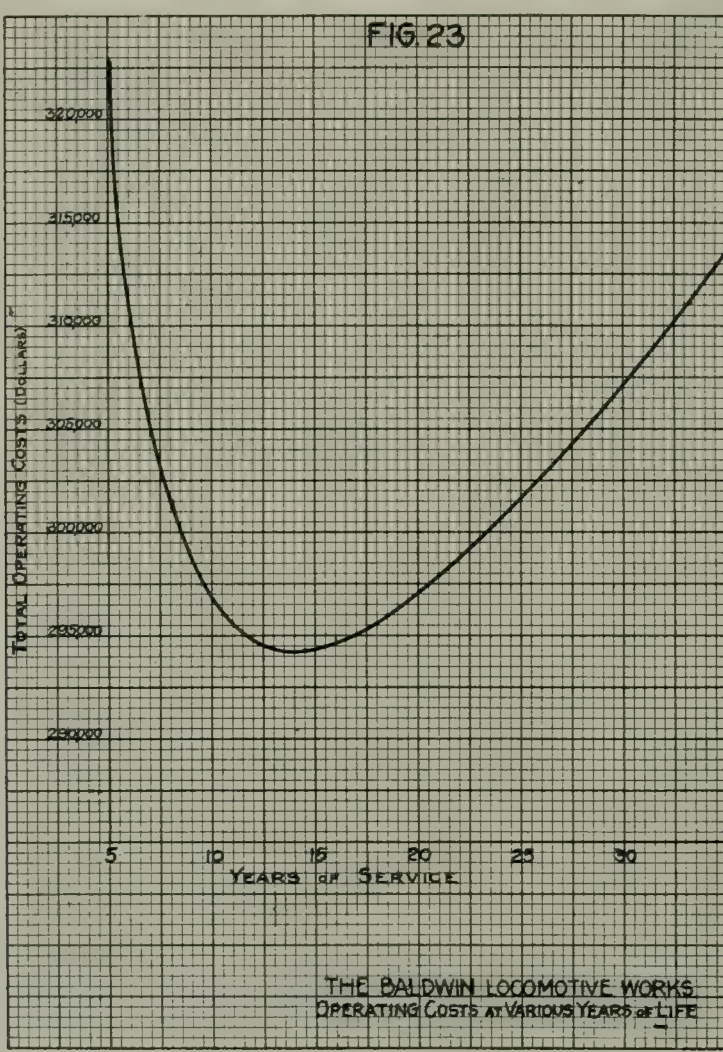

Figure 23

ation per year from five to thirty-three years' service life. The results of these calculations are shown in Figure 23.

In each case the depreciation has been based on relationship to the life. The curve of cost on this figure shows clearly that the economic life of the new locomotives in this particular case varies between twelve and sixteen years, and that if you operate the locomotives for a less life than this, it will be done at an increase in operating expense, reaching a figure of over $322,000 for a five year life. If, on the other hand, you continue the locomotive in service after sixteen years, you will do so with a rising cost of operation from roughly $295,000 a year to $311,000 at a life of thirty-three years. When you consider that this picture is one covering the service of three locomotives only, it is quite evident that the correct determination of

Total Cost of Operation—5% Depreciation and 5% Interest on Outstanding Capital

Year of Investment	Constant Costs See Figure 17	5% Interest on Book Value	Taxes and Insurance	Depreciation	Cost Locomotive Repairs	Total Cost of Operation
1	$168,427	$18,000	$3,960	$18,000	$35,559	$243,946
2	168,427	17,100	3,852	18,000	62,297	269,676
3	168,427	16,200	3,744	18,000	72,937	279,308
4	168,427	15,300	3,636	18,000	78,303	283,666
5	168,427	14,400	3,524	18,000	81,577	285,928
6	168,427	13,500	3,416	18,000	85,760	289,103
7	168,427	12,600	3,272	18,000	89,034	291,333
8	168,427	11,700	3,197	18,000	92,308	293,632
9	168,427	10,800	3,087	18,000	95,582	295,896
10	168,427	9,900	2,981	18,000	98,856	298,164
11	168,427	9,000	2,873	18,000	102,130	300,430
12	168,427	8,100	2,761	18,000	105,404	302,692
13	168,427	7,200	2,653	18,000	108,678	304,958
14	168,427	6,300	2,545	18,000	111,952	307,224
15	168,427	5,400	2,437	18,000	115,226	309,490
16	168,427	4,500	2,326	18,000	118,500	311,753
17	168,427	3,600	2,218	18,000	121,774	314,019
18	168,427	2,700	2,110	18,000	125,048	316,285
19	168,427	1,800	2,002	18,000	128,322	318,551
20	168,427	900	1,890	18,000	131,596	320,813
				Total		$5,936,867
				Yearly Average		$296,843

Figure 24

economic life of power and the purchase of new power at the expiration of this economic life will show a tremendous effect on the total operating expense of the road. There is also indicated the increase in net income that can be accomplished by a careful analysis of the operating costs and capital charges involved in locomotive performance. It must be understood that the curve, as shown in Figure 23, covers only the particular case that we have been discussing. However, the economic life of any fleet of locomotives can be predetermined providing the trend of the cost of repairs of the road has been ascertained. The two factors that determine the economic life are first, the

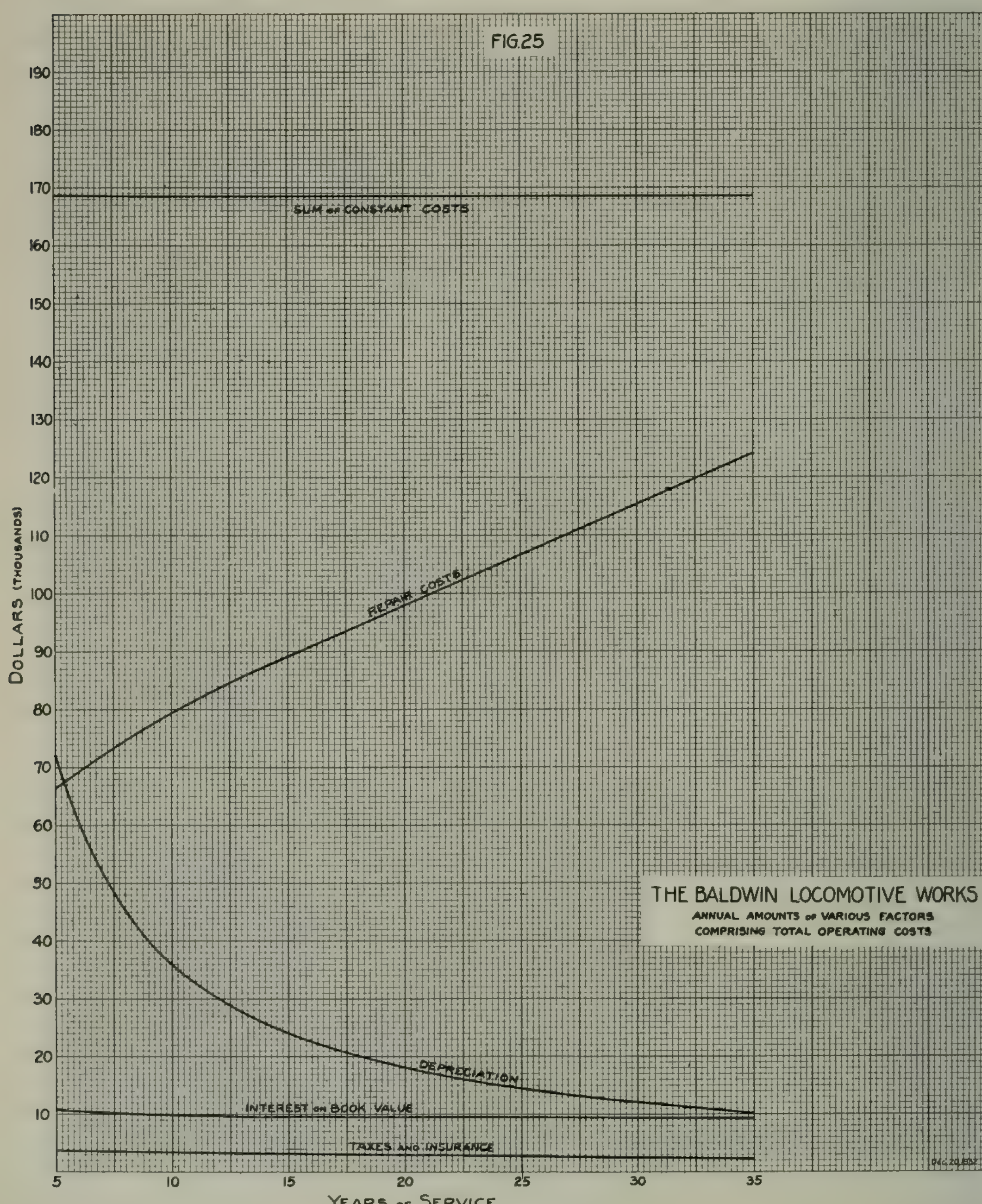

Figure 25

trend of the cost of repairs by year of age, and second, the average miles per year that the locomotives operate. This economic life will be shorter as the rate of cost of repairs by year of age increases and as the average locomotive miles per year increase. This would indicate that the most economic method is to select power suitable for the service required and obtain the maximum mileage in the minimum time.

The tabulation, Figure 24, shows the calculations for a twenty year life as plotted on Figure 23. The calculations for all other years were obtained in the same manner.

The relative effect of the various factors making up the average total cost of operation is shown very clearly when plotted. Such a plot is shown in Figure 25.

Starting at the top, we have the sum of the constant costs, which comprises the greatest single element. These constant costs include crews' wages, fuel, lubrication, other supplies, water and enginehouse movements.

Next in magnitude is the costs of repairs, which increase continually the longer the locomotive is kept in service.

The third item, that of depreciation, starts with a high value and drops very rapidly. The two lower items, interest on book value and combined taxes and insurance, are not of much moment and have very little effect on the trend of the total operating cost curve, Figure 23. The factor that drops the total operating cost during the earlier periods of locomotive life is depreciation. Its effect diminishes rapidly and is overcome by the rising cost of repairs. This cost of repairs becomes the ruling factor in increasing the total cost of operation.

It is quite evident from a careful study of Figure 25 that within practical limits the economic life of a locomotive is less than twenty-one years. This is not a new thought but we believe our method of approach is new and presents the matter clearly and concisely, and this method can be used in predetermining the most economic length of life of any fleet of locomotives.

Before closing I want to present the other side of the picture, i.e. where the locomotive in use is considerably larger than required for the service. Cases of this kind are often met in switching service where large switching locomotives or large road locomotives set back in switching service are used on switching jobs where considerably less power is required. As a rule locomotives found in these situations are old in years and extremely high in their cost of maintenance. In order to bring

out the salient points I will take an extreme case where a locomotive thirty years old of 1500 horse power capacity, working two shifts per day and doing the work that, for easy comparison, could be done by a 300 horse power oil or gas-electric. An economical type of steam locomotive to do this work would be a side tank locomotive without tender and with a capacity of 500 potential horse power. The relative hourly cost of the old and new steam locomotives would be about as shown in Figure 26.

Cost Per Hour Operation

	Old Power 1,500 H.P.	New Power 500 H.P.
Fuel	$0.70	$0.30
Wages	5.63	5.63
Lubrication	.04	.03
Other Supplies	.03	.03
Water	.014	.006
Enginehouse movements	.37	.37
Repairs	1.62	.12
Total	$8.40	$6.48
Savings per hour new over old		$1.91
Savings first year (4,960 hours) new over old		$9,474
Savings per year less repairs		$2,034

Figure 26

We will not go into the intermediate steps required in obtaining comparative operating costs, but present the following statement, Figure 27, showing the cash set up using an estimated cost for the new locomotive of $17,000.

It will be noted from Figure 27 that in the case given the savings obtained will amortize the investment in practically two years, i.e. the locomotive will pay for itself in two years and at the end of twenty-one years, with interest compounded at 5% on the annual savings, will show an average yearly profit of $14,281, which is 84% on the investment. This certainly indicates the possibility of favorably affecting the net income by careful studies in the use of secondary power, and although you will not find many cases as drastic as this example, you will find plenty of instances where new locomotives of smaller size will make a very attractive return on the investment.

ar of vest- ent	Invest- ment 1 Loco. @ $17,000	Annual Savings	Interest on Reduced Invest- ment at 5%	Net Increase of Taxes and Insur- ance	Savings, Less Interest, Taxes and insur- ance	Reduced Capital	Betterment in Cash Position		
							Annual	Cumu- lative	Annual Com- pounded @ 5% for Period
1	$17,000	$9,474	$850	$187	$8,437	$8,563			
2		9,124	428	182	8,514	49			
3		9,184	2	177	9,005		$8,956	$8,956	$21,553
4		9,257		172			9,085	18,041	20,823
5		9,364		166			9,198	27,239	20,078
6		9,471		161			9,310	36,549	19,355
7		9,578		156			9,422	45,971	18,655
8		9,686		151			9,535	55,506	17,979
9		9,792		146			9,646	65,152	17,322
10		9,899		141			9,758	74,910	16,689
11		10,007		136			9,871	84,781	16,079
12		10,116		130			9,986	94,767	15,491
13		10,221		125			10,096	104,863	14,916
14		10,328		120			10,208	115,071	14,364
15		10,436		115			10,321	125,392	13,831
16		10,542		110			10,432	135,824	13,314
17		10,649		105			10,544	146,368	12,816
18		10,757		100			10,657	157,028	12,336
19		10,863		95			10,768	167,793	11,872
20		10,971		89			10,882	178,675	11,426
21		11,078		84			10,994	189,669	10,994
							Total		$299,893
							Yearly Average		$14,281

Figure 27

We have attempted to point out in this paper the possibilities of greatly decreasing the expenses which revolve around the use of locomotives. This decrease in expenses would become net operating income. When it is realized that over one-third of all operating expenses are controlled by locomotive use, these savings could gradually—through wider and wider use of new power—amount to some hundreds of millions of dollars annually. In no other phase of railroad operation is there anything like an equal opportunity to contribute to that rehabilitation of railroad earning power which is so sorely needed.

PRESIDENT: Gentlemen, the terms, locomotive operating costs, locomotive repair costs and locomotive efficiency are familiar to all of us, but I am sure we have all had a new pre-

sentation of these old familiar terms. The subject is now before you for discussion. You may have some questions you would like to ask Mr. Cook or you may wish to make some comments of your own.

MR. GUY M. GRAY: I would like to ask what reason is there for the increase in cost of repairs as locomotives grow older?

MR. COOK: Increased cost of repairs, as nearly as I can decide, is due to two things. One is the fatigue of metal which results in a greater breakage of parts as the locomotive grows older. The other is the maintenance of various parts which are not necessary in the earlier years. You have certain parts that you do not have to repair in your first classified repairs but you do in your second. In the third other parts have to be renewed. If you divide classified and running repairs you have about a 50/50 break, but showing practically the same trend. Your running repairs you have to take for granted because you have no other way to determine that except to get actual cost. In classified repairs I have taken the classified repairs of a given fleet of locomotives at different years of age and I actually find the trend of your Class 3 or Class 4 or Class 5 repairs in a straight line that goes up very rapidly. In the particular instance I have in mind classified repairs amounted to $2.00 per horse power in the first Class 3 repairs and twenty years later it was up to $4.00 per horse power.

MR. A. STUCKI: We know that there are locomotives that have had a life of forty and even fifty years. One of your charts shows the economic life to be in the neighborhood of fourteen years. Does that hold good in this age or to what extent does it apply to modern locomotive construction?

MR. COOK: That fourteen years was the economic life of those particular locomotives only. You will find that will vary. It will go lower and it will go higher. You have got to take each particular case by itself. But you can determine very easily the exact point of greatest economy.

MR. T. E. CANNON: Would not the unit of 1000 gross ton miles be just as good as the horse power unit?

MR. COOK: Yes it is, under certain conditions. One thousand gross ton miles is the work done by the locomotive and it would be perfectly proper to measure and control your repairs

by that unit, except that your cost per 1000 gross ton miles will vary with your speed and with your gradient. On a given division of a railroad it will cost more locomotive miles to handle the same 1000 gross ton miles. Your horse power unit instead of being cut down is always the ability to do work. And your cost remains the same irrespective of the 1000 gross ton miles handled.

MR. R. P. FORSBERG: I have been following your interesting talk as well as I could and I have found it particularly interesting. I would like to ask whether or not in your opinion it is desirable to charge all classified and running repairs against the individual locomotive.

MR. COOK: I am very glad you asked that question because it is the habit at the present time on various trunk line roads to discontinue that particular activity. I think it is very necessary and very desirable to charge the cost of repairs against individual locomotives. You have a piece of machinery that is worth anywhere from $50,000 to $150,000, and certainly in all manufacturing establishments the cost of maintenance of tools of considerably less value than that is kept very accurately. I would certainly think it desirable and almost necessary to keep the costs that way.

MR. JOHN A. RALSTON: I would like to ask if you give a locomotive the same service, main line service, year after year, if the trend of cost of repairs would not be rather low.

MR. COOK: No, I do not think so. I have taken these trends on numerous fleets of locomotives where they have been kept on main line service and have been used practically the same throughout the various ages in which we took them, and we find them in exactly the same trend. The costs increase with their age.

MR. KARL BERG: Mr. Chairman, with your permission, I would like to ask a few questions. The problem of applying repairs to locomotives is a very interesting one, and a very pertinent question in regard to maintenance of railroading right now, and no doubt will continue to be so in the future. It is one of the greatest questions involved.

What I would like to know is if the speaker has made any studies in regard to when or under what conditions repairs should be made, particularly how often classified repairs ought

to be applied. In other words, has any definite conclusion been reached in regard to when a locomotive should be completely torn apart and rebuilt, as is the case in connection with classified repairs.

I have heard a great deal of comment in regard to the possibility of improving wearing parts on locomotives to such an extent that the span between classified repairs can be greatly increased. I have also heard discussions for and against the idea of eventually eliminating so-called "classified repairs", making a locomotive operate from 100,000 to 500,000 miles before it becomes necessary to tear down and completely re-build same.

Another question is—if a locomotive is made modern and efficient with the application of such adjuncts as superheaters, feed water heaters, etc., in what proportion does that increase the cost of maintenance of a locomotive?

I also have another question with reference to application of running repairs. Our modern heavy locomotive requires a great deal of judgment with respect to the handling of running repairs, both with regard to the facilities to be used for applying these repairs, and with respect to losing as few service hours as possible. Thus, to what extent does the careful consideration of these points, namely, grouping the repairs and using proper judgment so as not to tear down parts that are unnecessary, affect the cost of maintenance?

MR. COOK: You are getting away over my head. That is your job. We would like very much to build locomotives for you that would run 500,000 miles without being torn down. We have not been able to do it yet. I say it is your problem, because this predetermination of mileage between classified repairs has been given considerable thought for the past fifteen or twenty years and in most cases you find that the particular railroad starts in with a given mileage and then gradually increases that mileage.

As to your question about superheaters and feed water heaters, all I can say is this. Superheaters and feed water heaters both increase horse power of the locomotive, that is they increase the ability of the locomotive to do work. If the locomotive is given that increased amount of work to do it results in an increase in the cost of repairs in proportion to the amount of work they do.

MR. D. W. McGEORGE: I would like first of all to express my appreciation of the paper. It seems to me many of

the points brought out are unknown to the railroad men. The railroads have been getting along with their present methods of accounting. Why do you think a new system is required?

MR. COOK: I think the reason that we require something of this kind is simply the fact that we are being pushed a little harder than we were. It is very simple to improve something from 60% to 70% efficiency. As you go up to 80 to 90 to 95% it becomes harder and harder. The difficulty is the fact that in earlier years of railroading it has not been necessary to think about this problem. We have been pushed primarily to handle increase in traffic. Now we have got to a point where there is no increase in traffic and we have got to get down to the lowest possible operating cost. Therefore we have got to view everything, locomotive repairs, track maintenance, car maintenance with a view to getting the least possible cost and the greatest possible net income. Insofar as locomotive repairs are concerned, natuarlly I do not know of any better unit than the one I talked about, the hores power unit.

MR. F. K. LAYNG: Would it be desirable to keep repair costs on the horse power unit basis?

MR. COOK: I would say it would. It will give you a good deal better basis of comparison of your performance and as between different railroads, if you think you can compare them. I have not seen roads yet that I felt justified in comparing, but it does give a very good control of your own costs. Determine your trend line and then determine your annual cost and spot it on your trend line and you know instantly whether you have made an improvement or are going backward.

MR. M. F. MANNION: If you do get your cost, your rated horse power cost, reduced to a cost per mile, on what basis do you arrive at cost per hour, per locomotive hour?

MR. COOK: In that case I was referring to switching service converting horse power units into cost per mile and multiply that by 6 to get it into cost per hour.

MR. MANNION: Does that include road service too?

MR. COOK: No, I would keep my cost of road service if I wanted it for any individual engine, on the cost per mile. Personally I like the cost per horse power unit, but that is new and hard to grasp.

MR. MANNION: Would it be permissible or could you convert locomotive operating costs to a locomotive hour cost and enter that saving in terms of locomotive hours?

MR. COOK: If you use the total average miles per hour you would arrive at the same result whether you base the savings on hours service or miles service. But insofar as road service is concerned I would see no reason to change it from a cost per mile. I have found this on roads I have examined, I have had locomotives of the same age, practically the same horse power and a group of them in freight service at an average speed of 20 miles an hour, making 40,000 miles per year. Another group in passenger service running 72,000 to 80,000 miles per year, and I found no difference in cost per horse power unit. In other words the speed is apparently compensated in the decrease in power. In other words the repairs are practically based on the amount of water evaporated. You could put it on the pounds of water evaporated if all locomotives had the same type of superheater and the same boiler pressure.

MR. MANNION: If you speed up your locomotive running time by eliminating delays so you could get into terminal an hour earlier, would there be a saving in fuel consumption and repairs and water for that reduced hour's delay?

MR. COOK: No, I haven't found any reason to change the cost of repairs per mile or per horse power unit due to increased speed of the locomotive. It would be the same on a train mileage basis, it will cost the same irrespective of the time. That is of course assuming that you load your engine in proportion to the speed. If you take 1000 tons and carry it at fifteen miles an hour you will have less cost of maintenance than if you carry that same tonnage at forty miles an hour with the same locomotive. On the other hand if you load a locomotive at forty miles an hour or ten miles an hour up to its capacity you will have the same cost per mile.

MR. KARL BERG: I would like to ask just one more question. I believe a good many, beside myself, are interested in the application of roller bearings to locomotives. It is one of the new and outstanding developments, although there have been comparatively few applications up to the present time.

The question I would like to ask is—if any figures have been compiled, or any opinion reached as to what extent, if any,

the application of roller bearings decreases the cost of maintenance of locomotives.

MR. COOK: I could just give you my opinion. I think Mr. Walter Sanders is here and might want to say something about that. I would simply give a reflection of what I have heard from other people, and that is that roller bearings applied to trucks, trailers and tenders, do form an economic installation. Due to the fact of less hot boxes they justify the expense. I believe there is some question yet as to whether or not you are justified in the application of roller bearings to your main drivers. The big saving of course will be in the cost of maintenance, and the cost of maintenance for hot boxes on main drivers is considerable. But we have not had enough installations of that kind to make any certain deductions. It is just guessing.

PRESIDENT: Will Major Sanders please make a few remarks on roller bearings.

MAJ. WALTER C. SANDERS: Mr. President and Gentlemen: From our experience I believe I can say that there will be very few locomotives built without roller bearings. The roads which are using roller bearings on locomotives find them highly satisfactory. Maintenance charges are reduced and availability is increased. We are now ready to go ahead on bearings for all driving axles. We have an application which will fit into existing pedestal openings without any changes to speak of. As Mr. Cook told you, we have been in production on engine truck, trailer and tender applications for some time.

All of the new electric locomotives on the Pennsylvania have Timken bearings on all driver and truck axles and we have over 410 steam and electric locomotives running which are either completely or partially equipped. It may be of interest to note that the Northern Pacific has purchased the Timken experimental locomotive. Mr. Binkerd, Vice President of Baldwin, is here and I'm going to ask him to say a few words about roller bearings from the standpoint of the locomotive builder.

MR. ROBERT S. BINKERD: I do not know very much about it. But from what I do know I believe that, by reason of better lubrication and saving a lot of time spent in dropping wheels and renewing and adjusting brasses, you should be able to increase the amount of time during a year that a locomotive

is available for service. And to increase by 10 or 20 days a year the availability for service of a modern locomotive should show a high return.

MR. G. W. WILDIN: I notice in all the Technical Journals in which the Baldwin people advertise and in the publication which they issue themselves invariably large locomotives are illustrated and described. I would like to ask whether in speaking of modern locomotives Mr. Cook has in mind large locomotives only?

MR. COOK: No, not all. I think there are nearly as many cases in this country where you can save money by using a smaller locomotive than to use a large locomotive, as the cost of running a locomotive that is too large for the work is certainly excessive, and if that locomotive is old you will get a tremendous saving by the substitution of a new locomotive of proper capacity.

MR. C. O. DAMBACH: I would like to ask whether in the use of large locomotives you recognize any increase in the expense of the Maintenance of Way Department.

MR. COOK: I have not. I have talked over that question with a number of maintenance of way engineers and I do not know that anybody has the answer. The larger locomotive of course means greater weight on bridges and tracks; it also means considerably less application of that greater weight. Whether the result is more or less cost I do not know.

PRESIDENT: Prof. Endsley may we hear from you?

PROF. LOUIS E. ENDSLEY: I am glad indeed to be here to listen to this talk on locomotive operation. As you know all the great prophets had a great many scholars. Our present speaker is surely something of a prophet. Whether it is good or bad depends on whether it lives or dies. I believe it has some good points in it. I haven't much to say, except this, that these roller bearings, if they will wear as they say they will, will pay for a lot of cost in the saving of friction. I had opportunity at one time to run some bearings the way you run thousands of bearings now, with nothing but grease, and it takes several pounds of coal to keep those bearings hot enough to lubricate. And that is the saving that may come and it may come along with an increased draw bar pull and a saving in repairs. I know nothing about the locomotive that is

being put out, but it is interesting from that standpoint. I think Mr. Cook has given all you locomotive repair men something to think about.

MR. J. W. WYKE: Is it good practice to make switchers out of old road engines?

MR. COOK: Generally speaking no. Of course there is a qualification as to the term "old." If it is ten years old and fits the job it may be used to advantage. If it is much older it might not be used to advantage. But I would suggest in that substitution it would be a good plan to work out your operating cost due to locomotive performance itself and determine whether or not you are justified in the application of the locomotive to that particular service.

MR. E. EMERY: In your charts you depend on your trend line. I was wondering how often this should be taken off to be of any particular service.

MR. COOK: If the railroads started to measure their cost of repairs in horse power units the spotting of the actual cost each year would determine whether or not it was necessary to revise the trend line. If you take a trend line and the costs follow it you do not need to revise it. If you find you are going higher or lower for some reason you should revise it. Another point must be given consideration and that is that you cannot take a trend line at all periods. You would have a very misleading trend line if you took it for 1930, 1931 and 1932, because you would have considerable deferred maintenance.

PRESIDENT: Br. Binkerd, I wonder whether you would have something to say on the question of converting the old engine or buying a new one, or on any other phase of tonight's subject.

MR. ROBERT S. BINKERD: Mr. President and Gentlemen: I would like to throw away the slide rule and the charts and just get down to a few brass tacks in dollars and cents. Here is a railroad industry with about two billion dollars invested in prime movers, and under normal traffic it has been spending in maintenance and operation of these prime movers nearly 70% of their original cost every year. This industry to which we are all beholden in one way or another is going to wind up this year having failed to earn its fixed charges by about $150,000,000. The year 1933 should be better than 1932,

but the railroads will probably be about $100,000,000 short of their fixed charges.

If what we think we have discovered be true, namely, that locomotive maintenance costs are determined primarily by the age of the horse power used, then if the railroads of this country could use today a locomotive inventory of the average age of 10 years instead of 20 years, they would be saving all that $100,000,000 shortage in fixed charges for 1933.

Take for instance, a railroad the size of the Lehigh Valley requiring about 4,000,000 horse power units to do its normal annual business, and using an inventory of 500 to 600 locomotives. If they were all new their 308 account would be about $1,600,000. But if the same locomotives doing the identical amount of work, are carried through the succeeding 35 years, the 308 account will be $8,100,000 in the thirty-sixth year.

If that be so, then by controlling the average age of a locomotive inventory you can control the 308 account. If you decide that 20 years is about the right turnover for a locomotive inventory, then by following the necessary policy of purchase and retirement you can bring about an inventory whose average age is 10 years. The moment you can do that on this sample road you would reduce the 308 account to about $4,250,000 and hold it there indefinitely as long as wages and prices do not change.

If you remember chart No. 23 tonight, showing the point where three locomotives in the same service should be retired to show the lowest average annual operating expense, you will realize that we have not started very far yet on the railroads of this country in handling our power in such a way as to show the lowest possible expense and the highest possible return on the investment.

None of you would think of retiring a locomotive doing satisfactory service when only 7½ years old. On that chart No. 23 you saw it would be expensive to retire that locomotive at 7½ years, because of the high cost of amortizing your original investment, which would have to go into operating expense in 7½ years. But go right along that same line and keep this same locomotive in operation when it is 26 years old, and it is just about as expensive as to retire it at 7½ years. The only difference is that you are then wasting operating expense instead of capital investment.

If what we believe we have found is so, then we are talk-

ing tonight about the greatest single thing the railroads can do to lift themselves by their own boot-straps.

The use of locomotives controls the largest related group of the costs of producing railroad service. Locomotive repairs, fuel, engine-crews, water, and round-house and incidental expenses are 30% of railroad operating expense. The size and character of locomotives also largely determine the number of train movements and therefore affect the expenditure for train-crews. Taking this also into consideration, the use of locomotives controls more than one-third of all present railroad operating expense.

The railroad interests of this country face their problems today with a locomotive inventory only about 17% of which was built within the period in which the modern locomotive was developed, which is roughly since 1920. About 30% of existing locomotives were built between 1910 and 1920. About half of the whole inventory goes back before the days of the superheater into the age of saturated steam. So that, in addition to the question of controlling the cost of repairs by controlling the age of the power you are using, you have a tremendous obsolescence because half of your locomotive inventory comes from the days of saturated steam. So far the railroads have been tackling this problem only in sporadic purchases, which in the past five years have slowed down to a point where they will turn over the present locomotive inventory only once in every 73 years!

Therefore I leave you with this question: Is the railroad industry of this country going to lift itself back to its former position without an aggressive policy of achieving the lowest possible operating expense through replacing obsolete and expensive old locomotives with the best modern power? If you can save one-third of the 308 account, one-third of the fuel, one-fifth engine crew wages, one-eighth of train-crew wages, and cut your terminal expense in two, in a normal year's operation—and that will come—the railroads of this country can take something like $300,000,000 out of their operating expense and transfer it into net operating income. These savings are more than the total tax bill of the railroads, more than the average annual cash dividends to stockholders. To what more important subject can any railroad man devote his thought and energy?

PRESIDENT: We are approaching our adjournment hour. Is there any further discussion?

MR. W. E. CORRIGAN, (American Locomotive Company): From my observation of the charts Mr. Cook has shown on the screen, I should say that the figures are certainly not exaggerated, and I congratulate him on a very complete and clear handling of the subject. Supplemental to his remarks, I wish to point out that, while these repair costs are increasing constantly year by year on old locomotives, the capacity for work is relatively decreased. In other words, the spread between the old existing locomotive and the new modern locomotive in capacity for work is widening out each year. The modern locomotive is constantly showing greater capacity per unit of weight on drivers and the difference in gross ton miles per train hour between the old and new offers economies which will bring handsome returns on the investment irrespective of savings in maintenance costs. The Lehigh Valley new locomotives are showing 38% return on the investment, and there are many others.

One gentleman here raised some questions on lighter locomotives used in branch line service. Greatest economies are, of course, obtainable in the large main line freight locomotive. However, we should not lose sight of the fact that there are many lighter locomotives in service of old design where substitutes can very profitably be made with a light modern economical locomotive offering great reductions in all expenses, including not only maintenance but in fuel and water costs and greater opportunities for increased service. Not all freight traffic is by any means handled in full tonnage trains and a lighter fairly high speed locomotive for trains of moderate size offers opportunities for savings that are relatively just as great as for the main line high capacity locomotive.

PRESIDENT: We have a reel of motion pictures to show and after that the usual lunch will be served.

MR. C. O. DAMBACH: At the dinner preceding the meeting I heard a great many remarks on the good quality of the food and the efficiency of the cook that prepared it. In view of what we have seen and heard this evening it is very evident that the Baldwin Locomotive Works has been able to present a very capable and expert Cook to serve the intellectual food for thought that has been presented to us this evening. I want to say that I have attended a great many meetings of the Railway Club of Pittsburgh but I do not remember any that has been so instructice or so provocative of serious thought as the

one we have heard tonight. Mr. Cook has shown us a great many curves and figures that have presented many new ideas. I would move that we giving a rising vote of thanks to Mr. Cook for the very interesting paper, and to include Mess'rs Binkerd, Hale and McNaughton for their entertainment.

The motion prevailed by unanimous rising vote, after which adjournment was had to the luncheon.

J. D. CONWAY, Secretary.

In Memoriam

JAMES H. CHAMPION,

Joined Club February 25, 1926

Died April 17, 1931

I. H. MILLIKEN,

Joined Club December 26, 1902

Died December 30, 1932

OFFICIAL PROCEEDINGS
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THE PLACE OF THE "CLARK AUTOTRAM" IN RAILWAY PASSENGER SERVICE

By MR. EUGENE B. CLARK, President of the Clark Equipment Company, Battle Creek, Michigan

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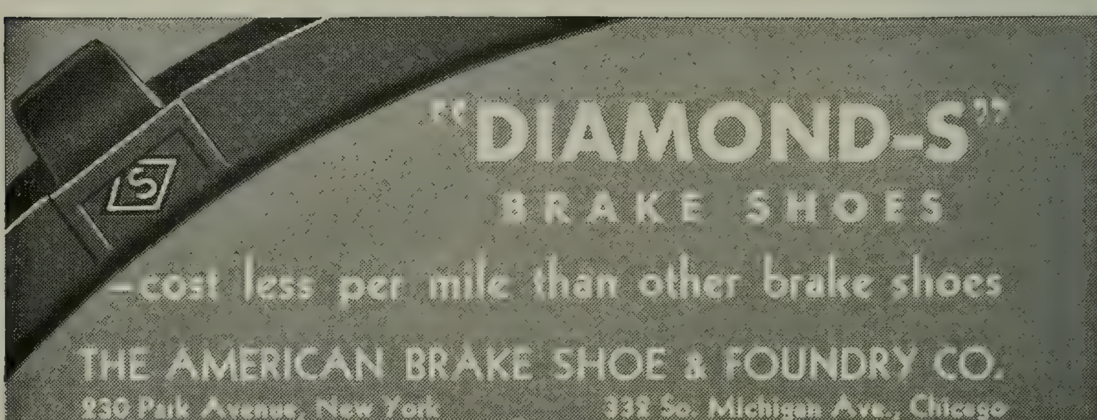
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Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING
FEBRUARY 23rd, 1933

The regular monthly meeting was called to order at the Fort Pitt Hotel at 8 o'clock, P. M., with President F. I. Snyder in the chair .

Attendance, as shown by registration cards, 233, as follows:

MEMBERS

Allen, Harvey	Ferguson, R. G.
Allison, John	Flinn, R. H.
Altsman, W. H.	Forsberg, R. P.
Anderson, Burt T.	Freshwater, F. H.
Ashley, F. B.	Fry, L. H.
Babcock, F. H.	Fults, J. H.
Balzer, C. E.	Furch, George J.
Barr, H. C.	Gilg, Henry F.
Batchelar, E. C.	Glenn, J. H.
Beam, E. J.	Goda, P. H.
Berg, Karl	Goodman, O. F.
Bihler, L. C.	Gray, Guy M.
Blest, M. C.	Grieve, Robert E.
Brown, E. L.	Grove, C. G.
Burgham, M. L.	Haller, Nelson M.
Burnette, G. H.	Hansen, William C.
Cannon, T. E.	Henderson, George L.
Carlson, L. E.	Herrold, A. E.
Carr, T. W.	Holmes, E. A.
Carruthers, G. R.	Hoover, J. W.
Carson, John	Hughes, I. Lamont
Christy, F. X.	Hughes, John E.
Church, S. L.	Hunt, L.
Conway, J. D.	Johnston, H. F.
Cooper, S. B.	Johnston, W. A.
Cotter, G. L.	Kapp, A. C.
Coulter, H. F.	Keller, R. E.
Courtney, H.	Klassen, F. G.
Dambach, C. O.	Kramer, W. E.
Davies, James	Kraus, Raymond E.
Davis, Charles S.	Kruse, J. F. W.
Dihle, James E.	Kulp, J. G.
Dixon, T. L.	Kummer, Joseph H.
Dunbar, Harold F.	Lanahan, Frank J.
Edwards, C. H.	Lanning, J. Frank
Emery, E.	Layng, F. R.
Emsheimer, Louis	Lee, L. A.
En Dean, J. F.	Leet, C. S.
Endsley, Prof. Louis E.	Loeffler, George O.
Ferguson, James H., Jr.	Long, R. M.

Longdon, Clyde V.
Lowry, William F., Jr.
Lynn, Samuel
Maliphant, C. W.
Manson, A. J.
Mayer, L. I.
Millar, C. W.
Misner, George W.
Mitchell, F. K.
Mitchell, W. S.
Moir, W. B.
Montague, C. F.
Morgan, Homer C.
Myers, B. E.
McGeorge, D. W.
McGinnis, Thomas P.
McHugh, C. A.
McIntyre, R. C.
McKinley, John T.
McMullen, Clark E.
McNamee, W.
Nash, R. L.
Norris, J. L.
Orbin, Joseph N.
Palmer, E. A.
Pickard, S. B.
Pringle, H. C.
Richardson, E. F.
Rudd, W. B.
Rumbarger, F. A.
Rutter, H. E.
Ryan, Frank J.
Rys, C. F. W.
Schaffer, W. E.
Schaller, A. J.
Schmitt, Raymond F.
Schrader, A. P.
Sekera, C. J.
Severn, A. B.
Snyder, F. I.
Stark, F. H.
Stearns, William G.
Stevens, R. R.
Stoffregen, Louis E.
Sutherland, Lloyd
Thomas, T.
Tomasic, N. M., Jr.
Trax, L. R.
Tucker, J. L.
Unger, Dr. J. S.
Van Blarcom, W. C.
Van Vranken, S. E.
Wheeler, C. M.
Winslow, S. H.
Wood, John H.
Woodward, R.
Wright, Edward W.
Wyke, J. W.
Young, F. C.
Yarnall, Jesse

VISITORS

Anderson, M. M.
Baker, B. P.
Baker, Philo
Baker, Virginia
Bishop, Donald
Bone, H. L.
Brandt, S. E.
Brickner, H. E.
Bryant, F. F.
Cable, T. H.
Carroll, Walter C.
Cooper, F. E.
Culp, J. W.
Cutler, D. E.
Cutter, T. C.
Davis, C. B.
Davis, William B.
Dobyns, I. L.
Dunham, B. W.
Ehle, A. H.
Fahrney, H. T.
Fairman, F. E., Jr.
Flatley, William J.
Foster, Michael
Fowler, W. E., Jr.
Fulkerson, T. B.
Furch, George J., Jr.
Garrison, William
Gemmell, R. W.
Gemmer, F. L.
Grier, L. N.
Hanlin, M. L.
Hartman, E. C.
Hauser, G. B.
Haynes, J. E.
Head, C. W.
Hines, C. W.
Hobbs, D. B.

Hyett, R. A.
Jack, E. A.
Jenks, Walter H.
Johnson, William M.
Johnstone, James
Jolly, T. D.
Kester, W. B.
Kulousek, V.
Lesko, A.
Lewis, Ralph S.
Lewis, S. B.
Meininger, C. W.
Metzger, C. L.
Metzger, Clyde
Metzger, Dolores
Metzger, Richard
Metzger, Virginia
Mikesell, T. R.
Mitchell, John W.
Moseman, C. G.
Murray, S.
Mussey, D. S.
McCormick, A. F.
McFadden, B. C.
Pivirotto, Carl
Pivirotto, Earl
Reese, J. O.
Reeve, F. J.
Reynolds, A. C.
Riley, L. G.
Rosanoff, B. P.
Sanders, C. R.
Schweibinz, P. J.
Shepherd, W. B.
Simpson, George
Smith, Sion B.
Stanley, George J.
Stearns, Earl
Stevenson, L. N.
Sturm, R. G.
Swindell, J. M.
Taylor, J. G.
Templin, R. L.
Thatcher, A. J.
Thokar, Daniel
Thompson, H. C.
Treptow, George R.
Ucker, C. I.
Vandivort, R. E.
Wareham, J. K.
Weidner, H. C.
Wentworth, A. S.
Whetzel, J. A.
Wickerham, F. A.
Williams, S. L.
Wilson, J. R.
Winstein, C. D.

PRESIDENT: The printed proceedings of the last meeting have been mailed to you and we will therefore dispense with the reading of the minutes.

We have a record of attendance on the registration cards and we will dispense with the call of the roll.

The Secretary will read the list of proposals for membership:

SECRETARY: We have the following proposals for membership:

Chesley, J. O., Manager, Development Division, Aluminum Company of America, Oliver Building, Pittsburgh, Pa. Recommended by James Davies

Cutler, D. E., Transportation Department, General Electric Company, Oliver Building, Pittsburgh, Pa. Recommended by Karl Berg.

Fortescue, Charles L., Consulting Transmission Engineer, West-

inghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Recommended by F. I. Snyder.

Hauser, G. Bates, Engineer, Development Division, Aluminum Company of America, New Kensington, Pa. Recommended by A. H. Wollen.

Logan, J. W., Jr., Engineer, Union Switch & Signal Company, 800 Wood Street, Wilkinsburg, Pa. Recommended by L. F. Howard.

Mussey, Delavan S., Engineer, Development Division, Aluminum Company of America, Wearever Building, New Kensington, Pa. Recommended by A. H. Woollen.

McKinnon, H. D., Engineer Development Division, Aluminum Company of America, New Kensington, Pa. Recommended by A. H. Woollen.

McLean, J. L., Representative, Barco Manufacturing Company, 4266 Wooster Road, Cleveland, Ohio. Recommended by Karl Berg.

Smith, Daniel J., Chief Clerk to Vice-President, U. S. Steel Corporation, Room 1517, 71 Broadway, New York, N. Y. Recommended by F. I. Snyder.

PRESIDENT: These proposals will be referred to the Executive Committee, in accordance with our By-Laws, and upon approval by that Committee the gentlemen will become members without further formality.

Is there any other business?

Gentlemen, the usual order of business will be changed somewhat, due to circumstances that are beyond our control. In connection with the change I think we are to have a very novel presentation of the subject. Mr. Eugene B. Clark, who was scheduled to deliver the paper, on account of being detained at his home by very important business, is not going to be with us in person, but he will give us his paper over the radio. I think we have never had such a delivery of a paper before this Club. I am sure we will appreciate this novelty. In the mean time we will fill in the time until the broadcast is scheduled by hearing from the band.

By courtesy of Mr. C. L. Metzger and the Standard Auto-Tite Joints Company the Club was entertained by the Monroeville School Brass Band, made up of girl and boy pupils of the school ranging in age from eight to fourteen years, trained and

under the direction of Mr. T. C. Cutter. The names of members of the band follow:

James Johnstone	Trumpet
George Simpson	Cornet
Clyde Metzger	Trumpet
Philo Baker	Cornet
Virginia Baker	Clarinet
Virginia Metzger	Clarinet
Carl Pivirotto	Saxophone
Dolores Metzger	Saxophone
Earl Pivirotto	Alto
William Garrison	Alto
Richard Metzger	Trombone
Michael Foster	Baritone
Daniel Thokar	Tuba
Donald Bishop	Drums

They rendered several selections during the evening and were well received by the audience.

PRESIDENT: One of the very serious problems of the railroads today is their passenger service. Passenger business has been drifting away from the railroads, in one way or another; a great deal of it is now on the highways, and it behooves the railroads to get such service as they can into a small and economical unit, more so than the present steam train. A great deal of thought and study has been given to this subject, and one of the men engaged in this study is scheduled to speak to us tonight on the subject "The Place of the Auto-tram in Railway Passenger Service". As I intimated a moment ago, Mr. Clark, President of the Clark Equipment Company, of Battle Creek, Mich., is unable to be here due to the fact that he is entertaining some very important railroad men at his plant today. So in place of his being here personally it has been arranged that he will broadcast his paper to the Club at 8:30, from Battle Creek.

Hook-up was then made and Mr. Clark's talk delivered as follows:

THE PLACE OF THE "CLARK AUTOTRAM" IN RAILWAY PASSENGER SERVICE

By MR. EUGENE B. CLARK, President of the Clark Equipment Company, Battle Creek, Michigan

When the railroad first came into existence it attracted much attention. People immediately were interested in the

"iron horse". Hearing much of the new development the public wanted to see it and then to ride on it. The result was passengers for the new system of transportation and it was due to the evident interest of the public in this novel means of transportation that the pioneers in railroad construction became inspired with the possibilities in the new transport field and as a result devoted their time and money to its development.

Now the novelty of railroad transportation has worn off to a large extent. Now it is other forms of transportation which offer novelty. It was about a quarter of a century ago that the automobile first came into existence as a practical means of transportation. Like the railroad vehicle in its early stages, the automobile provided a most unsatisfactory means of travel when compared with the older and safer railroad. Travel was more expensive by automobile—less reliable and less comfortable than by rail. However, it did possess one feature attractive to the traveling public—novelty. As a result it immediately attracted much attention and many passengers. Like the railroad it also attracted engineers, manufacturers and courageous investors. The automobile was improved, highways were built and an industry developed that now has reached a proportion which warrants its ranking with the greatest industries of the day. The story of the automobile bears a marked resemblance to the story of the railroad. A romantic interest attaches to the development of an industry, but in this case we have an interest that is more than romantic. The automobile, starting as a novelty, has become a serious competitor of the railroad. So far as the interests of the country at large are concerned, the automobile aids and reinforces the work of the railroad, but so far as the railroad is concerned the automobile is a troublesome competitor.

Just now the aeroplane is in somewhat the same stage as a transportation agent that the railroad was 80 to 90 years ago, and as the automobile was 20 to 25 years ago. The aeroplane now is an accepted vehicle of transportation, though it is less comfortable, more expensive, much more dangerous, less reliable, and in the final analysis seldom faster than the railroad. Nevertheless, throughout this period of depression, when both the railroad industry and the automotive industry are suffering severely from unfavorable business conditions the aeroplane is steadily and surely forging ahead.

A study of the trend of railway travel during the past decade or more shows that there has been a steady decline in pas-

senger traffic since 1920. This decline continued steadily from 1920 to 1929 notwithstanding a rising tide of prosperity throughout the country. Since 1929 the decline has been even more marked by reason, of course, of economic conditions. Expressed in percentages there has been a loss, in 12 years, of 52% in volume of revenues from passenger traffic. The loss in passenger car miles has been less, showing that passengers who travel on railroads are traveling longer journeys. It is the short haul business that has suffered most. Under present conditions railroads cannot afford to maintain schedules for this rapidly decreasing short haul passenger service and as a result the service available is being continually reduced, the result of which is to throw more and more traffic to competitive forms of transportation. The great question before us today is whether, by an improved short haul service this continuing loss may be stopped and perhaps much business already lost may be recovered. It is the speaker's belief that this much desired result can be attained. Railroad lines are the natural arteries of travel. Communities have been built up and have developed to a large extent by the existence of railroad lines, so the present railroad lines lie along the natural routes for the maximum travel. It is most reasonable to believe that a fast and frequent service over existing railway lines will be used by the public. If low prices can be offered to those who would travel by such service, the service would be doubly acceptable. However, the railroads cannot afford to reduce their prices unless they can reduce their costs. A vehicle to be adapted to this fast and frequent service must be capable of operating at low costs.

The automobile highway bus has been cited as an important competitor in the short haul railway field—and justly so. However, it is a competitor which the railroad need not fear if it can meet the competition with better service at a lower cost or even at an equal cost. To appreciate the opportunity that exists it is only necessary to remember that the average speed of buses in passenger service is 25.7 m.p.h. between terminals. The average passenger rate for this service is 2.81c. per mile. The short haul service of railroads offers a speed of 27.56 m.p.h. and a cost to the passenger of 3.6c. per mile (although round trip rates and excursion rates are now being offered by the railroads at lower prices). The above comparison is based on railroad service from which has been eliminated the longer express runs between larger centers of population. A study of the figures with reference to this longer service still

shows a bright opportunity for an auxiliary service at high speeds and at low rates for daylight runs only. It is to be noted that the average speed of the fast express trains between terminals is only 38.2 m.p.h.

The preliminary work carried on by our engineers in the design and construction of the Autotram was based upon the data referred to above and upon much other data along the same line. The Autotram is essentially a railroad vehicle to the design and construction of which has been applied many of the principles which have been found applicable in automotive construction. The fact that it is to run on rails makes it necessary that the vehicle shall be constructed along railroad lines. For instance, no steering mechanism need be provided but, on the other hand, the chassis of a highway automobile is not suitable for railway purposes.

The Autotram has a specially designed car body mounted on trucks as is usual for railroad vehicles and is self-propelling, with a gasoline engine as the prime mover and with means for communicating the driving power from the engine to the wheels along general automotive lines. So-called rail cars in the past have generally been of the gas-electric type. Such drives are simple in one respect in that the power drive is simple and Diesel engines which are capable of low fuel operating cost may be used. However, the handicap of heavy weight and heavy cost with the gas-electric drive and especially the Diesel engine drive is a serious matter.

Weight is an important consideration. While it is disadvantageous from the standpoint of cost of operation, still a certain amount of weight is essential in railroad service in order that highway crossings, spring switches, et cetera, may be negotiated safely. We have considered that rubber tired vehicles are not possible in the present state of tire development. Solid rubber tires are not suitable because of excessive heating of the rubber. Pneumatic tires in the present state of their development are limited to about 1800 pounds per tire and to comparatively slow speeds. Tire maintenance becomes a serious item even at small increases over the 1800 pound limit. Signal operation becomes complicated when rubber treaded wheels are used. We believe that the weights and speeds which are necessary objectives in this new type of vehicle preclude the use of rubber tired wheels.

Streamlining is an extremely important factor in the design of a car to meet the service we have in mind. It is the only

way in which relatively high speeds may be obtained without the expenditure of an excessive amount of power. Streamlining is coming to be recognized to a greater and greater extent as a valuable factor in other modes of transportation. Of course without streamlining water transportation at high speeds would be out of the question; without streamlining air transportation in its modern development would be practically out of the question. Streamlining is being applied to highway automobiles to as great an extent as is possible under the limitations of the design of such vehicles. Up to the present time streamlining has not been applied to railroad vehicles, but for a vehicle such as we have in mind, we find that streamlining is a most important factor. The power required to drive such a vehicle is used in two general ways: first, to overcome the frictional and rolling resistance and to negotiate grades; second, to overcome the resistance of the air when speeds greater than 30 to 40 miles per hour are being attained. Mathematical calculations and wind tunnel testing reveal with surprising clearness the great saving in power by the proper shaping of the vehicle for the higher speeds. It is hardly the place to present formulas, but it is of interest to note that a speed of 80 miles per hour the power required to drive a properly streamlined vehicle is less than 50 per cent of the power that would be required to drive the same vehicle if built along conventional lines. To double the size of the power plant not only introduces many problems into the design of the power drive but more than doubles the weight of driving mechanism. As speeds increase, the advantage of streamlining rapidly becomes greater and greater. Furthermore, increased weight of power plant and drive increases the required weight of body and trucks and thus handicaps the effort to obtain rapid acceleration.

The body of the Autotram has received careful attention from the standpoint of safety, strength and lightness. After long study of numerous materials and combinations of materials, aluminum alloy was decided upon as the best material of construction. This material is not only light and strong, but it is of a yielding nature rather than brittle. The alloy which was adopted is known as Duralumin. Its toughness, its lightness and its strength make it peculiarly fitted for our purposes.

The body is of what is known as the center sill type; a deep and strong fish-belly beam extends from end to end under the car floor. This beam has a buffer capacity considerably in excess of A.R.A. specifications. This type of construction was

adopted principally in the interest of safety, 'though it also has other advantages. The only steel or iron used in the body are the rivets. The sides of the car are of double wall construction. Insulating material completely fills the space between the inner and outer shells of the walls, roof and floor so that the effect of external temperature changes is minimized and also the car is to a high degree sound-proof.

The drive from the power plant to the wheels is of the type known as mechanical drive as distinguished from the so-called electric drive. In general, the principles of automotive construction have been followed in designing and building the drive, but the peculiar requirements of a drive which must extend from a power plant in the body to driving wheels on a swiveling truck have necessitated departure from orthodox automotive drives. Certain other features not necessary for ordinary automotive purposes have also been included. All units are of sturdy construction, specially designed for this particular service.

The closest possible attention has been given to the safety and to the comfort of passengers. The type of body is such as to produce the maximum of strength with the minimum of weight. Rubber has been used to a wide extent in mountings of the power plant and the various units comprised in the drive from the power plant to the wheel; also rubber has been freely used in mounting the body on the trucks and in the wheels themselves. The windows are of double glass, the inner pane being of the safety type and both panes being fixedly sealed in rubber. Inasmuch as the windows do not open, ventilation is entirely artificial. Through specially designed ventilating apparatus, a moderate degree of air conditioning is obtained. Waste heat from the engine is used to heat air in wintertime; refrigeration may be used to such extent as is desired in summertime. Air within the car may be changed as rapidly as desired up to as much as a complete change every minute. This is the most important factor in ventilation comfort. Smoking may be allowed freely without discomfort to non-smokers.

The body is carried upon semi-elliptic springs with means for prevention of side-sway. The spring suspension and the lightness of body with low center of gravity is responsible for a highly satisfactory steadiness of operation.

One of the important elements for comfortable and smooth running is the wheel. It has been considered wise and perhaps necessary that the standard contour of railroad wheel rim be

used. In order to lighten the wheel construction, however, and to insure against the noise of wheel rolling contact being telegraphed up into the car body, great attention has been given to the design and construction of a resilient type of wheel. Rubber has been used in a different manner than is usual in resilient wheels inasmuch as the resiliency is obtained by the use of live rubber carrying its load rather than in compression. The problem of wheel construction has been largely to determine the proper use of the rubber and in this we have been greatly assisted by the rubber manufacturer.

The brakes are of the automotive rather than of the railroad shoe type. Time does not permit me to go into details of this subject but suffice to say for the moment that the objective in brake design has been to obtain absolute dependability and to insure easy and reliable braking.

A railroad unit for use in main line service must operate all signals. The signal system on a light weight unit involves some changes in the signal operating mechanism of the car. In the handling of this subject we have had able and valuable assistancce from the signal manufacturer.

Speed is an important characteristic in a vehicle such as this. One important interest which speed has is to satisfy the public desire for and interest in rapid motion. The public is interested in qualification for maximum speed but the railroad man is interested in the ability to maintain rapid average speed without too great maximum speed. To a certain extent, high maximum speed is antagonistic to high average speed. It is the ability to accelerate and decelerate quickly that makes high average speed possible. On the other hand, a car designed for high maximum speed must sacrifice in attaining the high maximum speed some of its ability to accelerate rapidly. The controlling object in establishing the speed of the Autotram is to obtain high **average** speed. As it now stands, the maximum speed is about 85 miles per hour, but no serious problem would be involved in raising this maximum speed to 100 miles per hour should that be considered desirable. High maximum speed can easily be obtained within reasonable limits, but as the speed increases the price at which it may be obtained also increases rapidly and ultimately becomes prohibitive from a commercial standpoint. Streamlining of course is essential at any speeds that now are considered high.

The second step in the development of a vehicle for the purposes of providing fast and frequent service at low cost is

the testing for performance of the completed vehicle. The Autotram has passed through a large number of performance tests and has given a splendid account of itself.

The third and final step is the application of such a vehicle, or a number of such vehicles, in actual railroad service. It is to be hoped that at an early date, through the co-operation of the railroads, this final test of this new vehicle will be accomplished. It is a pleasant thought in these days of business difficulties, which difficulties undoubtedly arise in large part from unemployment due to replacement of human labor by machine operation, to think that the building of a number of such vehicles as the Autotram, which is largely handmade will, if successful, not only help to solve one of the troubles of the railroad but will also help to solve one of the troubles of present-day society.

In closing I cannot refrain from extending our public thanks to the Aluminum Company of America, the B. F. Goodrich Company, the Union Switch & Signal Company and to many other companies as well as to many of our friends in the railroad fraternity too numerous to mention for the assistance which they have so generously extended to us in our attempted solution of the many problems which we have encountered.

Gentlemen, I thank you.

PRESIDENT: We are going to have a short reel of moving pictures showing in a general way the construction and operation of the Autotram car. In addition there are some slides to be shown, with some explanation by Mr. McKinnon.

MR. H. D. McKINNON (Development Division, Aluminum Company of America):

In designing the body of the Autotram two outstanding results were sought, namely, light weight and safety comparable with that of present main line passenger equipment. It was felt that these results could be achieved most economically and most completely by using a center bearing type of car body, utilizing the strong alloys of aluminum as structural material. Both stainless steel and magnesium alloy were given full consideration before the decision to use aluminum was reached. The former was eliminated because of its high cost, its requirement of special fabricating equipment and the fact that economical use of this material would necessitate some other body design than the center bearing type previously decided upon as best suited to the needs of the Autotram. Magnesium alloy was not used because of lack of previous experi-

ence with this material in railway service, and because the necessary sizes of shapes and plate cannot be produced commercially at the present time.

Since the Autotram is center bearing car, the most important underframe member is the center sill. This is a box-type, fish-belly girder built up of heat treated aluminum alloy plates and angles. Web plates are $\frac{1}{4}''$ thick and vary in depth from $5\frac{1}{2}''$ at the ends to $23\frac{1}{2}''$ at the center of span. The depth at the truck centers is $13\frac{1}{2}''$. The top cover plate is $\frac{1}{4}''$ x $38''$ while the bottom one is $\frac{1}{4}''$ x $28''$. Chord angles are $3''$ x $3''$ x $\frac{3}{8}''$. These center sill members are continuous throughout the $59'$ $2''$ length of the beam, except that at the rear end, for a distance of five feet, the webs and chord angles are replaced by $6''$ channels. The bottom cover plate, back of the rear center plate, is removable to permit access to the gasoline tank, which is mounted inside the center sill at this point.

The only non-aluminum parts in the entire body frame are the center plates, side bearing brackets, and center sill end castings. These parts are steel castings. The couplers, which are mounted upon the center sill end castings, are also steel. Since the car is designed for single unit operation only, no draft gear is provided. The couplers are bolted to double rubber blocks which provide sufficient cushioning for the infrequent service which they are called upon to provide. Steel rivets were used throughout the car, due to lack of proper equipment for handling aluminum rivets in the Clark plant when this first car was built.

Floor beams in the Autotram are $4''$ structural channels, spaced approximately $36''$ on centers. Alternate floor beams are reinforced with compression struts of streamline tubing anchored to the bottom chord angles of the center sill and to the floor beams by means of heat treated aluminum alloy castings. This arrangement enabled the designers to develop a strong, but extremely light, floor system, at the same time maintaining a much cleaner underbody appearance than would have been possible with the conventional type of cross bearers and floor pans.

The side sills are $\frac{3}{8}''$ x $6''$ bars with an extruded zee section riveted to the lower edge to provide a flange to which the bottom of the side girder sheets are riveted. The side sills are continuous from end to end of the car body except for the cut outs to accommodate the step wells at the entrance doors. All forming of side sills, as well as that of the center sill bottom chord angles, was performed without resorting to heating, using

an hydraulic operated "bull-dozer" equipped with Vee-block and die.

Floor sheets are 3/32″ cold rolled aluminum alloy sheet reinforced by light longitudinal angles extending between primary floor supports. A 1¾″ x 1¼″ x ¼″ angle supports the outer edges of the floor sheet, the inner edges being butted against, and flush with the top cover plate of the center sill. In the engine compartment and operator's cab ⅛″ floor sheets were used in order to carry the weight of miscellaneous equipment mounted in these compartments. The heaviest units, such as air compressor, auxiliary engine-generator and main engine are mounted directly on underframe members, and do not rely upon the floor sheet to carry them.

Side posts are extruded lipped channels, the metal thickness being ⅛″. This shape lends itself readily to side post application since it provides ample flange surfaces for the attachment of both girder sheets and interior finish. The same section is used for the carlines, which are continuous from plate rail to plate rail except at the front and rear where the streamline shape of the body necessitated splicing. All carlines were formed to the same contour, forming being accomplished without resorting to heating.

Anchorage for the carlines is obtained by means of an extruded acute angle section, the upstanding leg of which lies flush against the underside of the carlines. The horizontal leg of this section rests upon a 2½″ x 2″ x ¼″ plate rail angle, which ties the tops of the side posts together. In addition to providing a convenient and strong anchorage for the carlines, the use of this acute angle section adds considerably to the strength of the car sides, since it is a continuous member.

Small extruded channels are used for the window frames. Horizontal window frame members are clipped to the side posts, the upper ones providing a fastening for the lower edge of the letterboard sheet and window drip moulding, while the lower ones are riveted to the upper edge of the girder sheets and to the belt rail. The fact that the windows in the Autotram are fixed makes it possible to utilize the window frame members as integral parts of the body framing in this manner.

The girder sheets are ⅛″ heat treated plates, riveted to the zee section flange of the side sill at the bottom and to the 5/16″ x 3½″ belt rail at the top. Letterboard sheets are 3/32″ thick, as are the small panels between windows. Roof sheets are 5/64″ thick and are continuous across the car. They are fas-

tened to one leg of a special extruded eave moulding, the other leg of which is riveted to the upper edge of the letterboard sheet. The front and rear end roof sheets are $\frac{1}{8}''$ thick, and were welded in the center and hammered to the proper contour.

A large part of the striking appearance of the Autotram is contributed by the unique design of the front end. The radiator grill and pilot bars, being made of heat treated streamline tubing, harmonize with the other aerodynamic features of the body. The pilot bars are attached to channel frames at top and bottom by means of heat treated castings. Due to the severity of forming required for these pilot frame channels, it was necessary to form them prior to heat treatment. They are the only aluminum members in the entire car which were not formed cold. The anticlimbers, made up of 3″ and 6″ channels riveted together, were formed cold before assembly. The radiator top casting, in addition to providing a pleasing finish to the engine compartment hatch, is sufficiently strong to provide a tie between the end posts. A Pyle-National airplane wing landing light, equipped with standard locomotive lens, reflector and bulb, takes the place of the conventional headlight.

All doors on the Autotram are aluminum. Most of them were furnished by Morton Manufacturing Company, the single exception being the emergency exit door in the tail of the car. Folding steps are provided at the main entrances which are directly behind the operator's cab. These are interlocked to prevent being lowered when the entrance doors are closed. This is another example of the care which was exercised to provide a minimum of air resistance on the underbody surface of the car.

Immediately behind the entrance vestibule are two compartments which, in future cars, will be saloons. In this original Autotram only the left hand compartment is used for this purpose, the right one being equipped as a buffet kitchen. Suitable exhaust ventilators, mounted in the letterboard, provide ventilation for the compartments since they are not served by the forced ventilating system which delivers air to the main passenger compartment. The heating and ventilating equipment for the main portion of the car is located in a partitioned space in the left hand or saloon compartment.

The passenger compartment is 30 ft. in length, the rear 12 feet being separated from the forward portion by a half partition. At the rear of this club, or smoking compartment, a door leads to an unfinished compartment in the tail of the body. In

addition to providing locker space for the crew, this tail compartment houses the filler pipe of the gasoline tank. The emergency exit door previously mentioned opens outward from this compartment.

When equipped with standard coach or bus type seats, the Autotram has a seating capacity of 42 passengers. In this demonstration car all seats are individual aluminum chairs, eight of which are of the extremely light-weight, airplane type.

The interior metal work of the Autotram is entirely aluminum, unheat-treated sheet and extruded moulding being used for all parts except partition framing and panelling. These are of heat treated aluminum alloy. Attachment of interior trim was accomplished by means of self tapping screws. The entire car body, with the exception of the engine compartment and tail compartment, is insulated with Dry Zero blankets, top, bottom and sides. All partitions are also insulated with this material in the interest of sound deadening. The floor insulation is held in place by a false floor of thin aluminum sheet fastened to the bottom flanges of the floor beams. In addition to sealing the insulation against dirt and moisture, this false floor contributes the final touch to the elimination of wind resistance on the underbody. An additional sound deadening and insulating medium is provided by the installation of a sponge rubber pad, ⅜″ thick, on top of the floor sheets. A thick pile broad-loom carpet is laid over this pad.

Aluminum was used for a number of the special features of the car as well as for the principal structural items. Heat treated castings were used to support the main engine and upper bevel gear housing, as spacer rings in the resilient wheels and for the combined air brake and throttle control. Common alloy castings were used for lighting fixtures, curtain box ends, and various other pieces of hardware. Structural shapes were used as bed plates for the air compressor, auxiliary engine-generator, battery and signal dynamotor. Aluminum tubing was used for water piping and electrical conduct. The dual web plates of the resilient wheels are 5/16″ strong alloy plate discs.

A total of 13,500 lbs. of aluminum was used in the Autotram, of which about 10% was scrap. This scrap figure is quite small for an experimental car of such unique design, but in a production run would be found to be even smaller: at least 50 to 60 percent less. A large portion of the credit for the ease and rapidity with which the Autotram was built is due to the extensive use of extruded aluminum shapes. The extrusion

process permits production of many useful sections which cannot be duplicated except by using expensive pressing operations, and even then, only in relatively short lengths. This feature is of importance to the operator, from a maintenance standpoint, as well as to the car builder.

The aluminum alloys used in the Autotram body may be divided into two general classes, heat-treated and unheat-treated alloys. The former was used for all relatively highly stressed members and the latter for less severely stressed parts. All of the structural parts, including extruded structural shapes and plates, were of an aluminum-copper alloy known as 17ST, commonly called "Duralumin." This alloy has an ultimate strength of 50,000 to 60,000 lbs. per sq. in., and a yield strength of 30,000 to 40,000 lbs per sq. in. The majority of the interior trim was of an aluminum-manganese-magnesium alloy known as "4S". This alloy is not susceptible to heat treatment but, when cold rolled to the half hard temper, has a yield strength of about 30,000 lbs. per sq. in., or very close to that of 17ST. Most of the castings were a heat treated aluminum-copper alloy designated as 195-T4 having an ultimate strength of approximately 30,000 lbs. per sq. in.

Since the Autotram is not a duplicate of any existing car, it is not possible to make a definite statement as to the amount of weight saved by the use of aluminum. It is estimated that the body of the Autotram, if constructed of conventional car building materials, would have weighed at least 34,000 lbs. instead of 16,000 lbs. This increase of weight would have necessitated heavier trucks, axles, power plant and transmission, so that the resulting total weight of the car would have been in the neighborhood of 55,000 lbs. instead of 30,000 lbs., an increase of nearly 85%. In order to have obtained the same H. P. per ton ratio in the heavier car, a 300 H. P. engine would have been required. The extra cost of an automotive or marine engine of this size would be a large percentage of the cost of the aluminum used in the Autotram. The operating and maintenance costs of the heavier car would also be increased in proportion to the weight. The fact that these savings could be realized without departing from accepted standards of safe construction is felt to be ample justification for the choice of aluminum as the structural material for the Autotram.

PRESIDENT: Mr. A. F. McCormick, of the Clark Equipment Co., is present and he may wish to speak of some other features of the subject.

MR. A. F. McCORMICK: The cruising speed of the car is 70 miles an hour, with a top speed of 85. The car is 60′ long, drives on the front four wheels, and brakes on all eight wheels. The rate of stopping the car at 70 miles an hour is 1200′, at 35 miles, 180′. As to acceleration, it goes from standing to 40 miles an hour in 60 seconds. The weight on front truck is 17,200 lbs.

If there are any questions you wish to ask I will answer them to the best of my ability.

The gasoline consumption so far has shown a little better than 4 miles to the gallon. That includes main power plant and all auxiliaries.

PRESIDENT: If any questions occur that you wish to ask Mr. McCormick the opportunity is now given. Is there any one who will say something about the car? We will be glad to hear from any one.

MR. ARTHUR J. MANSON: (Westinghouse Electric & Manufacturing Company) I think Mr. Clark is to be congratulated on the contribution he has made to the railroad industry. There are four or five different points which are of particular interest. I will enumerate them in the order of the importance I think they occupy.

First is speed. We are all speed-minded. In these days we all want to go faster. The railroads have got to give better service than the automobile has been giving on the highway. The railroads have a lot of advantages over the highway transportation. They have their own right-of-way and rails on which they can run as fast as they want to go. They may have to fix their roadbeds and go to a heavier rail, but they have their private roadbed and protected crossings. Speed is a major consideration which Mr. Clark has incorporated in his car.

The second point he has contributed is light weight. He spoke about the light weight giving a saving in power, I think referring to the horsepower of the engine required to move this vehicle with a passenger load at high speed. There is another big factor in this which he did not speak about which is of interest to the railroads. With lighter weights, there is less wear and tear in the special work, crossings, etc. It is pretty hard to measure the saving in dollars and cents but, nevertheless, that is a very big factor.

The third point I have in mind is the construction or arrangement of this car body, etc. for the comfort of the passen-

ger. You are all familiar with the operation at high speed of certain vehicles, not always comfortable for the passenger. Mr. Clark has brought into his car construction an arrangement for supplying clean, pure air (air conditioning as it is commonly called) cooling it in hot weather, warming it in cold weather and giving proper distribution.

The next contribution is the resilient wheel. He spoke of the telegraphing of sounds up into the car body. That is an important development, as I see it, in this transportation problem, not only in the rail car but in other vehicles which run on tracks. From what little I know of the general fundamentals of design, I think he is on the right track in using rubber in shear rather than in compression.

Now I do want to say a few words to broaden the subject a little bit. Mr. Clark has mentioned that electric drive is heavier and costs more money. That is granted. It does cost more. But what we are all interested in is what will be the ultimate return of the value you get out of the dollar you spend. It may be that by spending more money for the electric drive you will get certain advantages which you will not obtain from mechanical drive. We know in general with many of the mechanical applications that the electric drive, even at its additional cost, shows a saving in economy after all. Electric drive has been applied to machine tools, shops and all those various applications. So that with the electric drive on a rail car you may get, under certain operating conditions, that this is the type of motive power you desire. Compared with mechanical drive, the electric drive gives you "rubber", so to speak, between your engine and your wheels. While I think there is a field for this light weight mechanical type of drive, I also know there is a very big field for the electric drive.

PRESIDENT: Thank you, Mr. Manson. Mr. McCormick?

MR. McCORMICK: I sold gas-electric equipment myself for some years and therefore I can not say anything against it. In this high speed field we can operate much cheaper than the gas-electric can. Take the gas-electric where it has to pull trailing units, there is no question that that is the answer. But in this work we only use about 60% of the horsepower at 70 miles an hour. At 70 miles per hour we use a little better than 85 h.p. With gas electric equipment where you have tonnage to pull it will do the job without any question.

PRESIDENT: I notice a number of Union Switch & Signal men here. I wonder if they could not tell us something about this car. Mr. Rudd?

MR. W. B. RUDD: I do not know a great deal about the details of the Clark Autotram, but it did bring up some problems in shunting the track circuits to work the existing signals. However, those problems have been solved satisfactorily and we will gladly furnish details of the track circuit shunting apparatus if desired.

PRESIDENT: Mr. B. T. Anderson, have you anything to add to this?

MR. B. T. ANDERSON: The rapidly growing use of light-weight gas or gas-electric cars, and the later introduction of the rubber-tired and rubber insert steel-tired wheel rail car, have brought about an acute safety problem because of the uncertainty of shunting track circuits by the usual method.

Anticipating this situation, we developed a system which insures track circuit shunting not only for light-weight cars with metal wheels but also for cars with rubber tires. This system requires no auxiliary apparatus upon or along the wayside, is confined entirely to the rail car itself, and makes unnecessary the running of such cars under manual block rules or other special instructions as a safety factor. It has been thoroughly tested out under service conditions and operates very satisfactorily.

The Union Switch & Signal Company desire to express their appreciation to the Clark Equipment Company for their co-operation in the installation of the track circuit shunting apparatus on the Autotram.

PRESIDENT: I wonder if we can get a comment from some of the railroad men who have used the self propelled cars. Mr. R. H. Flinn possibly can tell us something about the operation of rail cars.

MR. R. H. FLINN: I of course can not tell you anything about this Clark Autotram because I have never even seen it. But it does impress me as a very desirable development along this line. If we go back a few years when we made the first attempts to get away from steam locomotive service on branch lines, we started in originally with the gasoline car, which was driven pretty much as an automobile. It was not

any too successful. We had a great deal of maintenance difficulty, because that was the first development along that line. To speak about the gas-electric, we have done a good deal of experimental work with that in almost all sizes. Though we do not have some of the very heavy cars, we do have gas-electric cars up to 400 h.p. We made some mistakes with the gas-electric because some of our people tried to use them as locomotives. They have been successful in light branch line service and they can haul one or two cars, depending on gradient and other operating conditions.

The whole problem is one of reducing the operating costs per mile in branch line service where the revenue will not warrant steam operation. The gas-electric car runs somewhere between 45 cents and 50 cents a mile—over all cost—and that is not low enough when the revenue per mile on many of those branch line trains is considerably below that. If the revenue gets that low why not take the service off? As Mr. Clark intimated, a great deal of that has been done and we are in this position today that we have got to make the service pay or take it off. In a great many cases it is quite difficult to take it off. We feel that we are somewhat obligated to give service on some branch lines and the public authorities have some control over the situation, which makes it rather difficult to get away from it. We have abandoned service on a good many branch lines, because the revenue has fallen far below the cost of any method of operating the service. This last step, the Clark Autotram, is a good deal similar in principle to previous experiments, which have as the object the further reduction of the cost of operation. I do not suppose the Clark people have had enough experience yet to say just what the cost of operation will be. As I recall Mr. McCormick said it was somewhere around 30 cents—

MR. McCORMICK: 25 cents including cost of operation and a depreciation of 10%.

MR. FLINN: I recognize another factor in this. I do not think Mr. Clark or the other people interested in this development have entirely confined their thought to branch line service. They are thinking also about frequent service on main line, which is a phase we have not tackled yet. We have been trying to get the cost of our branch line operating service where the revenue will agree fairly with the cost of operation. When you get to the main line you have another problem, and

that relates to the volume and character of the traffic you have to handle. A car of this type would not be of any value in heavy commuter service. On a main line which serves a territory which might be built up, it would be valuable. Take that travel away from the highways and put it back on the rails and you could provide a service at a low enough cost to get a profit on the operation from the revenue you could secure. That is partly salesmanship and partly a frequent, fast service. That is something we have got to give more attention to. This passenger problem is quite a large problem and some have said within the last few years what we ought to get out of passenger service. Unfortunately we can not do it. We have still got that problem to work out.

MR. McCORMICK: As to the mechanical part we have eliminated all of that trouble. Shifting is automatic, assuming that you are referring to that subject. As a rule the oldest man on the railroad has the preferred runs and there are nine out of ten chances that he has been in service until he is 68 or 70 years of age. If he has an automobile it is without a gear shift. Put him on the old type mechanical car and if he shifts from first to third he is doing well. If he goes first, second, third and fourth it is perfect. We have seen them start at second and jump to fourth. Most of the troubles were caused by the men not knowing how to drive the car. The top speed of the old type mechanical car was 40 to 45 miles an hour. The top speed of the Autotram is 85. We are getting better than 4 miles per gallon of gas and about 750 miles to the gallon of oil.

PRESIDENT: Some mention has been made of the car being used as a locomotive. I do not believe we know whether it is a locomotive or a car. The Interstate Commerce Commission in their mileage statistics do not classify rail cars as locomotives, but under the heading of cars, notwithstanding they are prime movers. We have some P. & L. E. men here—Mr. Berg, a mechanical man, and Mr. Lynn, a car man. What have you to say, Mr. Berg?

MR. K. BERG: I wish to ask a question in connection with any difficulty that may arise in regard to the operation of signals where a light weight car is used: in other words, has this question been satisfactorily disposed of, or is it necessary to entirely rebuild the present signal system in order that successful operation may be guaranteed?

Another question, interesting to a good many I believe, is —what degree of safety to passengers is obtained with a light weight car as compared with the old, heavily constructed passenger equipment? If a collision should occur with a car of light weight against a heavy weight train, what would be the result? We would, of course, have to assume that the light weight car would be used on railroads where cars of heavy construction are operated.

MR. H. D. McKINNON: Replying to the question as to strength and safety, this car was designed to meet A. R. A. specifications for main line coaches. The maximum stress in the center sill due to combined maximum static load of 26,000 lbs. and a buffing load of 400,000 lbs. is only 23,000 lbs. per sq. in. This is slightly less than the maximum stress in the center sill of a standard Pennsylvania 70 ft. passenger coach under similar load conditions.

With regard to the effects of collision between an aluminum car and a steel car having a platform higher than that of the aluminum car, we are able to furnish some definite information as the result of an accident on the Philadelphia & Western last October. An aluminum car weighing 52,000 lbs. ran into a 65,000 lb. steel and wood car, which was standing in a station, at a speed of approximately 35 m.p.h. The platform of the steel car was 12 inches higher than that of the aluminum car so that conditions were extremely adverse to the aluminum car. Although the force of the impact was sufficient to break the cast steel coupler anchorage, no damage to the underframe or superstructure occurred back of the vestibule. The aluminum anticlimber received the full force of the impact from the coupler of the wood and steel car, and was badly battered, but not completely broken. Three vestibule posts were broken off and the vestibule end sheet was pushed back about three feet, but the center sill was only slightly bent and was straightened without being removed from the car. Not a pane of glass was broken, or even cracked, back of the vestibule. The side doors, which were of the folding type, operated perfectly after the accident, showing the absence of distortion of the superstructure. The damage to the wood and steel car was almost identical with that to the aluminum car, in spite of the advantage given it by its higher platform.

We can safely say that an aluminum car will withstand somewhat more impact than a similar car of steel. It is estimated that this margin is at least 40% even when the elastic

limit of the material is exceeded. Where stresses are below the elastic limit, an aluminum car will absorb an impact about three times greater than that which a similar steel car will stand, due to its greater resilience. This is based upon the comparative moduli of elasticity for the two metals; 10,000,000 for aluminum and 30,000,000 for steel.

PRESIDENT: Mr. A. H. Ehle, of the Budd Manufacturing Company, can you add anything?

MR. A. H. EHLE: (Edward G. Budd Manufacturing Company, Philadelphia, Pa.) I had not intended to engage in a discussion with Mr. Clark on the relative merits of stainless steel versus aluminum, nor the use of pneumatic tires, as compared to the design of wheel he employs in the Autotram. Neither do I wish to take advantage of his absence since he cannot reply to me over the radio. He has, however, made some statements with reference to pneumatic tires and his representatives here have also spoken of the superior results obtained with aluminum from the standpoint of resiliency and resistance to shock or deformation. In making such assertions I do not know what kind of steel Mr. McCormick may have in mind but it must have been of very ordinary quality because the strength of the stainless steel we use is far greater than that of aluminum or its alloys, and correspondingly in other physical qualities it is more permanent and resistant to destructive stresses. Mr. Clark mentioned, in dismissing consideration of pneumatic tires, that for operating on rails the wheel load was limited to 1800 lbs., whereas with the present state of the art, which is progressing rapidly, the permissible loading is actually 2400 lbs., or some 33% greater than he has stated. Their riding qualities are well known as compared to any other form of solid rubber or so-called resilient wheel and particularly so when running on an ideal surface such as steel rails. The traction is superior and the surface contact from 17 to 21 sq. in. As to their suitability for service, they have a record of some 300,000 car miles in France over a period of two years without any train detentions reported on account of tire failures. This is supported by our own experience in this country over a period of 15 months.

Reference was made to the braking ability of the Autotram, and although I do not recall the exact distance as stated by Mr. Clark, we made tests on the main line of the Reading Railway which demonstrated that with a dry rail our car could be

brought to a stop from a speed of 55 miles per hour in 350 ft. and with an entirely wet rail at the same speed in 385 ft., or a difference of 35 ft. The factor of adhesion for steel tired wheels on clean dry rails is generally considered as .25, whereas under the same conditions with pneumatic tires it is .60, this being largely the reason for the improved braking ability and the important increased safety factor in regular operation.

I do not recall exactly the weight of the Autotram but our car of greater capacity weighs 22,000 lbs.

MR. McCORMICK: The weight of our car is 30,000 lbs. What is the length and seating capacity of your car?

MR. EHLE: The length of one of the Pennsylvania cars is about 51 ft. and the seating capacity is 46.

I subscribe to what Mr. Manson said regarding electric drive and am quite familiar with the earlier results obtained with mechanical drive. I believe there is a place for mechanical drive under certain conditions, in fact we have had success with it ourselves. In speaking of the excessive weight of electric transmission, it should be considered of course that along with its function and smooth acceleration the true measure of its suitability is the all-around performance and the total weight of the vehicle itself.

Reference has been made to a car under construction for the Pennsylvania Railroad. I presume this refers to the two car unit we have just completed for that road and which will be placed in actual service next week between Norristown and Pottsville under the most severe operating conditions. The preliminary trials have been entirely satisfactory.

Reference has been made to what may be expected to happen with a light weight rail car of the type under discussion as compared to heavy weight equipment in the event of collision. The advantages are distinctly in favor of the light weight vehicle, providing it is properly engineered and of material such as stainless steel, which is so much stronger that that heretofore in use. It is well known that with any moving object the foot pounds of energy to be absorbed in collision are the product of mass times velocity and hence with the inherent strength referred to, assuming the use of these special materials now available, the advantage is with the light weight vehicle.

PRESIDENT: We are getting toward adjourning time.

We will be glad to hear from any one else who has any question or anything they would like to say. There is another gentleman from the Clark Company who wishes to add to the discussion. He has been introduced by letter and I will ask the Secretary to read this letter.

Battle Creek, Mich.,
February 22, 1933.

Mr. F. I. Snyder, President,
The Railway Club of Pittsburgh,
Pittsburgh, Pa.
Dear Mr. Snyder:

My brother, Mr. Eugene Clark, regrets very much that he cannot be with you tonight but he has asked Mr. M. L. Hanlin, one of our Vice Presidents from Buchanan, to represent him.

I am very sorry for you under this arrangement. Buchanan is a small town and you know what they call a man who comes from a small town. He has been most everything in Buchanan, mayor, fire marshal, superintendent of education, alderman and I think he is now "white wings". He is very fond of talking but my advice to you is to keep him quiet if possible. As you will have already noted, he is a very homely man but he has an obsession that he is good-looking. He considers that he has an acute mind but my opinion is that it is like a jig-saw puzzle with some of the pieces missing. If you are not successful in keeping him quiet please don't allow his looks or his words to influence you in your opinion of our company.

The best of luck for your meeting.

Very truly yours,
(Signed) Ezra W. Clark.

PRESIDENT: I will assume that Mr. Hanlin is now properly introduced. But I did not need an introduction. I have known him a great many years.

Mr. Hanlin then followed with a very humorous talk and stories.

MR. C. O. DAMBACH: I rather hesitate to get up after that flow of oratory. But we have had a wonderful meeting this evening, a lot of fine music, a lot of informative discussion and a lot of oratory. This radio presentation is something new that it might be well to keep in mind. The next time we have a subject presented by radio we might arrange some way that the other railway clubs could all tune in.

I think Mr. Clark deserves a lot of credit for embarking in this field. There is no question that he is on the right track. The only question is whether he can get his costs down low enough to meet competition. In any event it is a start, and if the cost can come down there is no question that there is a field for the Autotram. I think Mr. Clark is deserving of a vote of thanks from this Club for the very able paper we have heard this evening. I think that vote of thanks should also include Mr. McCormick and Mr. McKinnon for their very able discussion, not forgetting our friend Mr. Hanlin. He is so modest that he did not tell us anything about the Clark car but I think we will all remember the Clark car by remembering Mr. Hanlin. I move that we extend a rising vote of thanks to these gentlemen and also to the Band for the most interesting and instructive discussions and the wonderful entertainment that we have had this evening.

The motion prevailed by unanimous rising vote. There being no further business ON MOTION Adjourned.

J. D. CONWAY, Secretary.

OFFICIAL PROCEEDINGS
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SPRINGS PAST AND PRESENT USED IN DRAFT GEARS

By PROFESSOR LOUIS E. ENDSLEY, Consulting Engineer, Pittsburgh, Pa.

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OF

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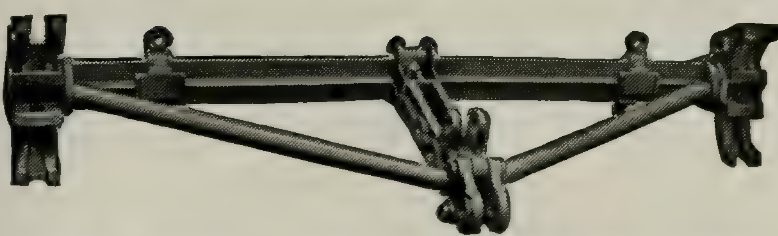

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*D. J. REDDING	November, 1908, to October, 1910
*F. R. McFEATTERS	November, 1910, to October, 1912
†A. G. MITCHELL	November, 1912, to October, 1914
*F. M. McNULTY	November, 1914, to October, 1916
J. G. CODE	November, 1916, to October, 1917
*D. M. HOWE	November, 1917, to October, 1918
*J. A. SPIELMANN	November, 1918, to October, 1919
H. H. MAXFIELD	November, 1919, to October, 1920
FRANK J. LANAHAN	November, 1920, to October, 1921
SAMUEL LYNN	November, 1921, to October, 1922
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GEO. D. OGDEN	November, 1923, to October, 1924
A. STUCKI	November, 1924, to October, 1925
F. G. MINNICK	November, 1925, to October, 1926
G. W. WILDIN	November, 1926, to October, 1927
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LOUIS E. ENDSLEY	November, 1930, to October, 1931
JOHN E. HUGHES	November, 1931, to October, 1932

†Resigned.
*—Deceased.

Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING
MARCH 23rd, 1933

The meeting was called to order at the Fort Pitt Hotel at 8 o'clock, P.M., with President F. I. Snyder in the chair.

Registered attendance, 144, as follows:

MEMBERS

Altsman, W. H.
Ambrose, W. F.
Ament, F. C.
Bair, J. K.
Barr, H. C.
Batchelar, E. C.
Berg, Karl
Blest, M. C.
Buffington, W. P.
Burgham, M. L.
Campbell, J. T.
Cannon, T. E.
Carlson, L. E.
Carson, John
Cipro, Thomas
Conway, J. D.
Coombe, A. B.
Courtney, H.
Crenner, J. A.
Cutler, D. E.
Dambach, C. O.
Dempsey, P. W.
Dickinson, T. R.
Eagan, D. F.
Edwards, C. H.
Emery, E.
Emsheimer, Louis
Endsley, Prof. Louis E.
Ferguson, R. G.
Flinn, R. H.
Follett, W. F.
Forsberg, R. P.
Geisler, Joseph J.
Gilg, Henry F.
Glaser, J. P.
Glenn, J. H.
Gray, Guy M.
Hansen, William C.
Harper, John T.
Henderson, George L.
Hilstrom, A. V.
Holmes, E. H.
Honsberger, G. W.
Huff, A. B.
Hughes, John E.
Johnson, William M.
Johnston, H. F.
Kapp, A. C.
Kaup, H. E.
Kelly, L. J.
Klassen, F. G.
Kruse, J. F. W.
Kummer, Joseph H.
Layng, F. R.
Leet, C. S.
Lewis, Goodrich Q.
Logan, J. W., Jr.
Longdon, C. V.
Maliphant, C. W.
Mason, S. O.
Mayer, L. I.
Miller, J.
Misner, George W.
Mitchell, F. K.
Mitchell, W. S.
Moir, W. B.
Molyneaux, Dawes S.
Morgan, A. L.
Morgan, Homer C.
Mussey, D. S.
McAbee, W. S.
McHugh, C. A.
McIntyre, R. C.
McKinley, John T.
Nash, R. L.
Osborne, Raymond S.
Palmer, E. A.
Pringle, H. C.
Ralston, J. A.
Rauschart, E. A.
Richardson, E. F.
Rutter, H. E.

Schaffer, W. E.
Schmitt, Raymond F.
Sekera, C. J.
Severn, A. B.
Sharp, H. W.
Simons, Philip
Smith, J. Frank
Snyder, F. I.
Stevens, R. R.
Stoffregen, L. E.
Stucki, A.
Suckfield, G. A.
Sullivan, A. W.
Thomas, T.
Trax, L. R.
Tuttle, C. L.
Van Blarcom, W. C.
Warfel, J. A.
Wheeler, C. M.
Wikander, O. R.
Winslow, S. H.
Wright, Edward W
Wyke, J. W.
Yarnall, Jesse

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Barnhart, B. F.
Baughman, G. W.
Bone, H. L.
Bright, William
Campbell, J. D.
Canfield, L. T.
Christenson, J.
Clausen, Harold C.
Connell, J. R.
Cree, W. M.
Eckels, W.
Frazier, Vose
Geiger, C. F.
George, W. J.
Gibson, Glenn, Jr.
Harvey, William R.
Hedge, T. R.
Hilbert, Rudolph F.
Lesko, A.
Lewis, S. B.
Linker, Edward
Lowe, T. C.
Mason, Robert
Mason, Walter
Miller, Bernard
Miller, Ted Paul
Murray, S.
Riddile, H. C.
Sheparson, F. C.
Sheparson, Mrs. F. C.
Smith, Sion B.
Snyder, Mrs. F. I.
Terkelsen, B.
Thompson, H. C.
Tripp, Winfield C.
Vandivort, R. E.
Westerman, M. A.

PRESIDENT: Gentlemen and Ladies: Before we go into the business meeting, we will be entertained by Mr. Fred C. Sheparson, who will sing a number of songs for us. He will be accompanied by Mrs. Sheparson. Mr. Sheparson is Paymaster of the Bessemer & Lake Erie Railroad at Greenville, Pa., and he and Mrs. Sheparson have kindly consented to come down to entertain us tonight.

We are very grateful to Mr. and Mrs. Sheparson for this delightful entertainment. We appreciate very much their coming down here to be with us tonight.

We will now proceed with the business meeting. The minutes of the last meeting have been printed and distributed to the members and we will therefore dispense with the reading of the minutes.

The record of attendance is complete on the registration cards and we will dispense with the roll call.

The Secretary will read the list of proposals for membership.

SECRETARY: We have the following proposals for membership:

Horan, F. T., Superintendent, Lake Terminal Railroad Company, Lorain, Ohio. Recommended by J. M. Morris.

Kelly, J. R. Secretary to Chairman, Westinghouse Electric & Manufacturing Company, 1720 Gulf Building, Pittsburgh, Pa. Recommended by F. I. Snyder.

Murray, Stewart, Salesman, Joseph Dixon Crucible Company, Jersey, City, N. J. Recommended by A. E. Herrold.

Thompson, Howard A., General Engineer, Union Switch & Signal Company, 311 West Swissvale Avenue, Edgewood (Swissvale P. O.), Pa. Recommended by W. B. Rudd.

PRESIDENT: These proposals will be referred to the Executive Committee, in accordance with our By-laws, and upon approval by that Committee the gentlemen will become members without further action by the Club.

SECRETARY: It becomes my sad duty to announce the death of one of our members in an adjoining country, Sir Henry W. Thornton, until recently at the head of the Canadian National Railways. His early association with railroad work was in our own vicinity and he later became distinguished abroad, receiving his title from the King of England in recognition of distinguished service during the World War. He joined this Club on April 28, 1927, and died March 14, 1933.

PRESIDENT: An appropriate memorial minute will appear in the next issue of the Proceedings. Sir Henry reached a position of great eminence in the railroad world in this country and also abroad, as you all know.

Are there any communications?

SECRETARY: My attention was called to a circular received today which gives a very lucid explanation of why railroad men in speaking of locomotives classify them in the feminine gender and have thought it may be of interest to our membership to present this to the Club tonight, giving due credit to the author, which reads as follows:

W. S. Scarboro, road foreman of locomotives for the Central Vermont Railway, believes he has solved the reason why locomotives are referred to as "she".

"There are many reasons," says Mr. Scarboro. "For instance they wear jackets with yokes, pins, shields and stays. They have aprons and laps, too. Not only do they have shoes but they sport pumps and even hose while they drag trains behind them. They also attract attention with puffs and mufflers and sometimes they foam and refuse to work. At such times they need to be switched. They need guiding and they require a man to feed them. They all smoke but most characteristic of all is that they are much steadier when they are hooked up."

PRESIDENT: We come now to the paper of the evening, which will be presented by one of the veterans of this Club—in point of service, not of age—one from whom we often hear in our discussions. His papers are always interesting and we always enjoy what he presents in the discussions. Tonight we have the subject, "Springs, Past and Present, Used in Draft Gears," by Professor Louis E. Endsley, a Past President of the Railway Club of Pittsburgh.

SPRINGS PAST AND PRESENT USED IN DRAFT GEARS

By PROFESSOR LOUIS E. ENDSLEY, Consulting Engineer, Pittsburgh, Pa.

Steel springs were used alone as draft gears in the American Railway cars many years ago. The first arrangement was a single coil spring, somewhat like the present "G" spring, which is listed in the A. R. A. Standards. The "G" spring consisted of an outer and inner coil. The outside diameter is 8-inches and the free length 7⅞ inches. The travel of this spring is 2⅛ inches. The load necessary to put the "G" spring solid is 30,360 pounds. The foot pound capacity of this spring solid is approximately 2,200 pounds. The spring weight is approximately 55 pounds, so that the capacity in foot pounds is about 40 pounds per pound of spring. Now this capacity in foot pounds per pound of metal is a figure that will be referred to several times in this paper, so please keep this figure in mind—namely —40 pounds per pound of weight in the spring. The center coils of a coil spring taken alone have a capacity higher than

the whole spring due to the end coils not all working. The center coil of the "G" spring has a capacity of about 49 foot pounds per pound of metal.

There is another form of spring that because of its unusual length is not used very often, but it is almost as effective as the coil spring, that is a straight steel rod. For instance—if we had a tempered steel rod 59 feet long and 17/32nds of an inch in diameter, we could apply a load at the end of this road of 20,300 pounds, which is the capacity of the outer coil alone of the "G" spring, and the same maximum stress of 90,000 pounds will stretch this rod 2⅛ inches. Now the maximum stress in the "G" spring has always been figured by the old formula as 80,000 pounds. Under recent experiments by Mr. Wall of the Westinghouse Electric and Manufacturing Company, he showed that the old formula did not give the correct maximum stress on the inner surface of a coil spring, and under his analysis, the "G" spring will give a maximum of a little over 90,000 per square inch. So this straight rod, which is 59 feet long, will weigh 44.5 pounds, and it will produce a capacity per pound of metal of approximately 39 foot pounds per pound of metal.

In other words, the straight rod under tension has practically the same spring capacity under the same stress as the coil spring. However, in a coil spring it is a torsion stress and in a straight rod it is a direct tension stress. However, if we only consider the center coils of the spring and the center of the long rod without the end connections of each, the coil spring is 25% more efficient under the same stress than the straight rod, when we assume a modulus of elasticity of twelve million for the coil spring and thirty million for the tension rod spring. To show this resilience of a long straight rod a comparison can be made, as was made by the writer some years ago, in which a piano wire 1/16th of an inch in diameter and 60 feet long was suspended from the roof of a high ceiling room, and a seat fastened to the lower end. Now, a two-hundred pound man sitting in this seat would stretch this piano wire 1 6/10th inches, and a 384 pound weight would stretch it 3 inches, and this all within the elastic limit of the steel, for it is an easy thing to produce a small wire to carry a stress of 125,000 per square inch, which is below its elastic limit, and the 384 pound weight produce 125,000 pounds stress per square inch. This wire as a spring would have, under a maximum of 384 pounds on it, a capacity of 75 foot pounds per pound of wire. Alloy steel coil

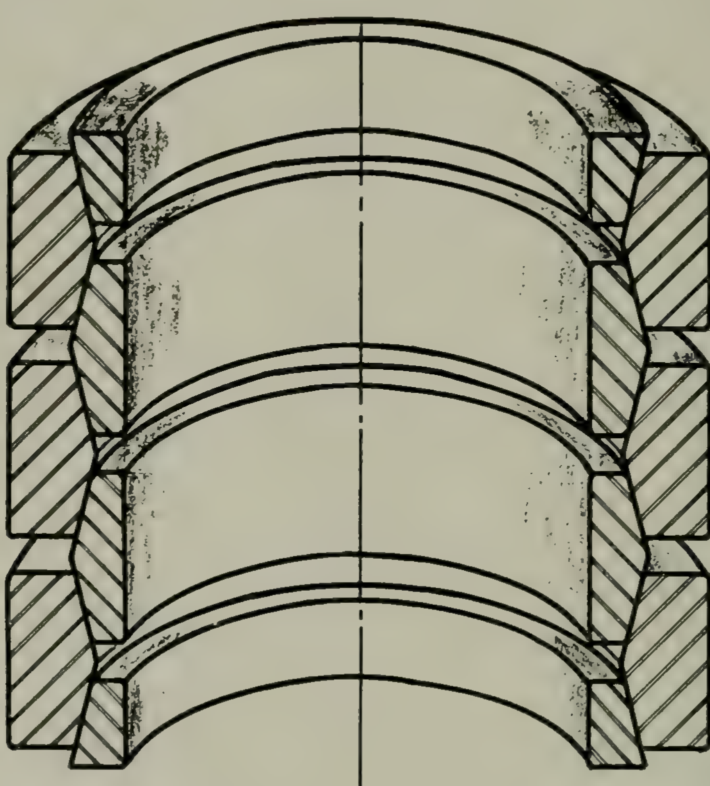
springs have also been used of small diameter wire that produce good results under 125,000 pounds stress, and if they are correctly designed, they will produce a foot pound capacity of 75 to 80 per pound of metal. This is about the limit of capacity that a coil spring without friction can produce. There was, however, produced some years ago a friction coil spring known as the Harvey Friction Spring. This spring consisted of two coils; one coil wound the same as any coil spring with tapered ends and another coil that was wound with a larger pitch diameter, but not as long and did not have tapered ends. The inner coil had conical surfaces on the outside, and the outside coil had conical surfaces on the inside. After these two coils were made and tempered, the inner coil was threaded into the outer coil, the same as a bolt is threaded into a nut. Now, when a load was applied to the inner coil, and a small compression occurred, the outer coil was expanded, and this caused the outer coil to slip both crosswise and lengthwise of the inner coil. The lengthwise slipping only occurring at the end of the outer coil. This produced friction between the inner and outer coils and gave this spring considerably higher capacity than the ordinary coil spring. The Harvey spring produced, as a draft gear, about 90 foot pounds per pound of metal in the spring. The design and manufacture of the coil springs used in most draft gears are very carefully done.

Now another form of spring that has been used in draft gears is the leaf spring. This is well illustrated in the oirginal Waugh Plate Spring Draft Gear, where one-quarter inch plates were used in four groups of twelve each. Later, four groups of sixteen plates were used. Here the spring is in flexure, but the only part of the metal of the spring that is under maximum stress is the outside fibre of each individual plate, and while more weight of spring can be put in a given sized draft gear pocket than could be with the coil spring, the capacity of the spring in foot pounds was never over about 40 pounds per pound of metal used. However, the maximum stress ran up a little over 125,000 per square inch. Here, however, some of this capacity was obtained through the friction occurring between the ends of the plates. With four groups of sixteen plates each, the plates weighed approximately 300 pounds, and this gear developes a capacity of 12,000 foot pounds. Thus, each pound of spring in the draft gear produced 40 foot pounds capacity per pound of spring plate.

A few years ago the Ring Spring was brought out and a

capacity of 200 foot pounds per pound of steel in the spring has been developed. This is the highest capacity ever developed in a spring. The way this has been done should be of interest to all of you here tonight.

A word of description may be necessary, so that Figure 1 is shown and gives a view of a few rings which go to make up the Ring Spring. As shown in Figure 1—it consists of a series of outer and inner integrally closed rings. The outer rings have conical surfaces on their inside and the inner rings conical surfaces on their outside. These rings are fitted together, the outer ring alternating and co-acting with the inner ones so as to form a column. When axial pressure is applied to this column, the outer rings will be expanded and the inner rings will be compressed, and each conical surface will telescope into the adjacent one, the travel taking place between each pair of conical surfaces.



SECTION THRU RING SPRING
FIG. 1

From an inspection of Figure 1, it is evident that the capacity of a draft gear made up on these principles depends upon the size of pocket in which it is to go and upon what stress can be safely carried by the steel. Thus, it is desirable to have a

steel that will carry a high stress without failure, both in tension and compression. At the present time, the outer rings, which are in tension, carry a working stress when solid of approximately 125,000 pounds per square inch; and the inner rings, which are in compression, carry a stress of approximately 210,000 pounds per square inch. Now, in order to take care of these comparatively high stresses, a new form of manufacture of the ring had to be resorted to. All sorts of rings have been made for other purposes, such as machining off ends of tubes; also machining rings out of flat plates, but no method of rolling such small rings, as were to be used in the draft gear, had yet been developed. And, while rings can be made from flat plates by machining and other means, the stress which this ring should stand had not been satisfactory for these higher stresses that were necessary in the Ring Spring draft gear, so that the ring is now manufactured by shearing cylinders of metal from a round bar, much less in diameter than the final ring. This cylinder of metal is pierced and rolled on all four sides until its outside diameter is approximately 8 3/16th inches for the outer rings, and 6 3/16th inches for the inner rings. This piercing of a small slug out of the center of the bar eliminates the ingot core that might have been left when the bar was orginally rolled. The rolling on all four sides makes a much better ring due to this rolling, as it is a known fact that a steel test bar is not as good, will not have as great an elongation or reduction of area, or as high elastic limit when it is cut crosswise of the direction of rolling, as when it is cut lengthwise of the direction of rolling. The method of manufacture had to be precision in order to have the desired free and solid height of the draft gear. This required that the exact amount of metal be used for each ring before starting the rolling of the ring. After some experimenting, it was found that if the bar to be sheared was heated to a temperature of 1000° Fahrenheit, the alloy steel used had a clean, square break, producing very accurate weights of slugs. There are no finishing cuts made of these draft gear rings; they are only sand-blasted.

As mentioned before, the stress in the outer ring is 125,000 pounds per square inch and 210,000 pounds in the inner ring. Now, the elastic limit of the steel after treating is between 180,000 and 190,000 pounds per square inch. Thus, it will be seen that the inner rings are stressed above their original elastic limit. But a new elastic limit is created by making the inner ring just a little larger than they are in the finished gear, so

that in the first compression after assembling of the gear, the inner rings are given a permanent set. There are five or more complete compressions made on each gear before shipping. This allows some tolerance in manufacture of the rings. This high stress can do no damage, as the inner ring is under compression, but gives the metal in the inner ring a very high efficiency from the standpoint of foot pounds of work per pound of metal.

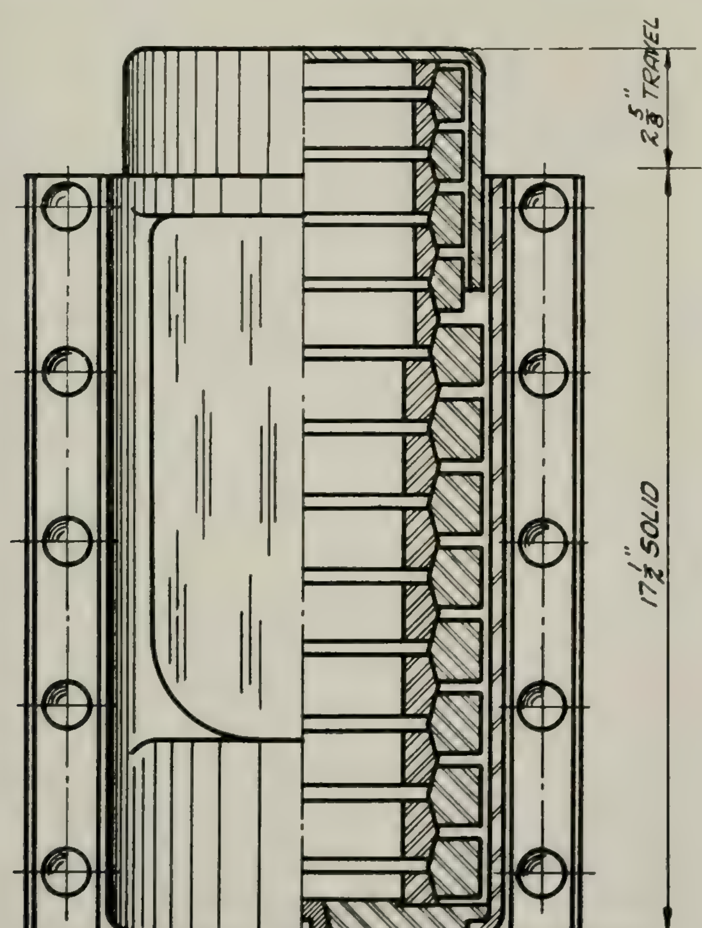
Another problem which developed with the manufacturer was that of the method of treatment of the steel to produce a ring that would be capable of working tension up to 125,000 pounds per square inch, and in compression of 210,000 pounds per square inch, and at the same time get a metal that would stand the high surface pressure between the conical surfaces. This pressure is as much as forty to fifty thousand pounds per square inch, and as it is a known fact that metals of the exact composition and heat treatment do not work together as well in friction contacts as two metals of different heat treatment or composition, a method of treatment was produced that gives a different texture of surface for the outer and inner ring. Thus, in the manufacture of these rings, the inner and outer rings are given different treatment, with the result that galling is eliminated.

Another discovery was that the outside surface of the rolled bar during the original rolling and heating of the slug for forging decarburized some of the surface, and this decarburization is finally rolled to the outside surface of the rings. This is the wearing surface of the inner ring, and this decarburization is corrected by a treatment which recarburizes this surface on the inner ring. This recarburizing of the surface can be done with safety on rings that are in compression. The exact practice is to carburize the inner rings at about 1575° Fahrenheit in natural gas at a pressure of 12 to 15 pounds per square inch, then they are reheated and quenched, then tempered. The outer rings, due to the piercing of the slug and the rolling from a small to a large diameter, shows very slight decarburization on the wearing surface, so these rings are cyanided. The order of treatment for the outer rings is to normalize, cyanide and quench, then temper. This cyaniding of the outer rings gives a very uniform hardness, and a hardness that is considerably above the surface hardness of the carburized inner ring.

Another problem which had to be solved before the Ring Spring acted in its now satisfactory manner was that of providing a satisfactory lubricant for the rubbing surfaces. After

a great many tests of different combinations at different temperatures, such as occurring in the United States, a very satisfactory result has been obtained by using two types of grease, each kind containing about 30%, by weight, of graphite. One of these greases that is rather stiff is used to coat the rings when they are originally assembled, and the lighter grease to fill the interior of the draft gear to provide continuous lubrication.

The problem of securing the proper coefficient of friction is very important. The coefficient that is now obtained is approximately 10%. Figure 2 shows a freight car draft gear, and with the twelve outer and eleven full inner rings and two half inner rings, the total capacity of this gear is approximately 27,000 foot pounds. Its release capacity in foot pounds is 11,000. Thus, the gear absorbs 16,000 foot pounds, which is about 60% of the total capacity. The weight of all the rings in this draft



RING SPRING DRAFT GEAR
FIG. 2

gear is 150 pounds. Thus, as compared to the coil spring, as mentioned before, each pound of this Ring Spring has a foot pound capacity of 180.

A little analysis of what each pound of metal does is interesting. From an inspection of the Ring Spring as illustrated in Figure 1, it is apparent that the inner and outer rings receive the same amount of force, that is, there is the same pressure on the inner rings as the outer rings—they merely react on each other. The outer rings are greater in cross section than the inner rings and have less stress than the inner rings. Now the expansion of the outer rings and the contraction of the inner rings are proportional to their average diameter when under the same stress, but as the inner rings are also under a greater stress, the product of the size and stress is the real comparison, so the following formula is given to make this direct comparison:

$$T = \frac{D\ S}{M}$$

In which T is the total expansion or contraction in inches
D is the mean diameter of the ring in question
S is the stress in pounds per square inch
M is thirty-million, or the modulus of the elasticity of the steel.

Now, this formula shows that the outer ring expands .029 inches and the inner ring compresses .037 inches, and that the total movement of both rings amounts to .066 inches; of this the inner rings gets 56%, and the outer ring 44%. Now, as I said before, the loads must be equal on the two sets of rings so that the inner rings, which weigh 45 pounds, do 56% of the work and figure a total of 336 foot pounds per pound of metal, this due to all metal being in high compression stress. This is over 8 times as much as the capacity of the "G" spring in the first part of my paper; and the outer ring has a foot pound capacity of 113 foot pounds. This is over two and three-quarter times that of the "G" spring. This is all accomplished by the spring itself, without extra friction members. This foot pound capacity accomplishment in Ring Springs is the largest for any form of spring ever designed. The action of the gear is very smooth both in compression and in release, and the lubricated friction surfaces gives practically the same capacity in a static test as in a dynamic test.

Forced closure curve is shown in Figure 3. Here the pressure is plotted against the travel of the gear. It will be seen that the compression line starts at about 30,000 pounds, and is a straight line from 50,000 to about 110,000, here it takes a steeper slope—this is due to the preliminary rings going solid

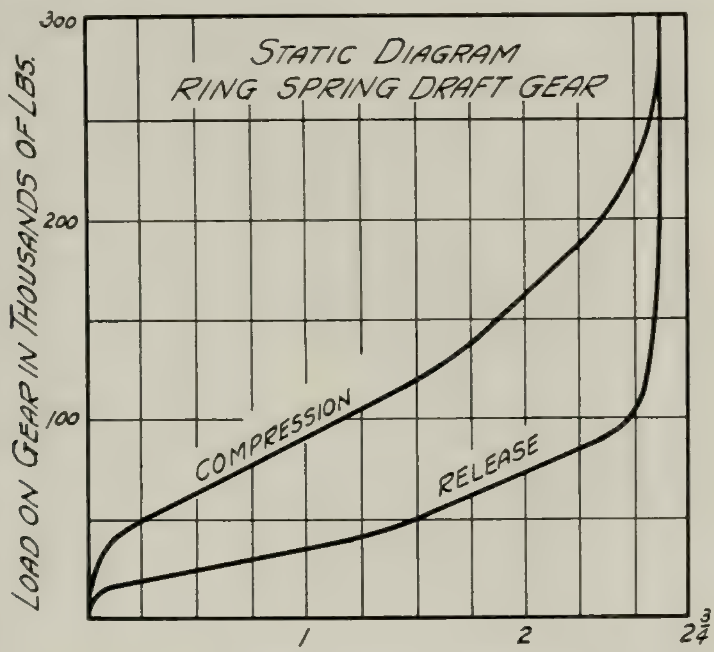


FIG. 3

at about this point, and after this point the main heavier rings give all the movement. The release has the same characteristics, for at about the same travel of 1½ inches, the curve makes the same movement to a lower slope on the release line. The curve shows that for the freight car gear, the rings are assembled in the housing under a compression of about ⅜-inch. This serves for two purposes, for until there has been considerable wear, there will be no slack in the gear, and the oil placed in for lubrication cannot get out, but will remain within the gear until all this original compression has been lost.

It is the writer's opinion that the Ring Spring Draft Gear, as developed, has a capacity that is about the limit of the present size of pocket for draft gears, but I believe that American railroads need a larger capacity, but until more room is allowed for the draft gear, the limit of capacity has been reached. For the 70-ton and 90-ton cars, a draft gear that has a capacity of forty or fifty thousand foot pounds is desirable, but this will require a larger pocket and probably an increase in the travel of the draft gear in compression, at least of an inch or more, in order that the final pressure will not be too high for the

coupler shank. For, if the travel is kept at 2¾ inches and 50,000 foot pounds is developed, the final pressure on the coupler shank will be at or above its elastic limit.

I wish to thank the Edgewater Steel Company, who manufacture the Ring Spring Draft Gear, for the assistance they have given me in preparing this paper.

PRESIDENT: The subject is now open for discussion. We would be glad to hear from any one. And if you have any questions to ask, I am sure Professor Endsley will endeavor to answer them.

There are a good many mechanical men here who ought to be able to discuss this question.

MR. HAROLD C. CLAUSEN (Union Switch & Signal Company): I have been very much interested in this paper and have learned a lot from it. The Professor has given us a very lucid address.

I have been principally interested in the paper from a theoretical standpoint as to why the ring spring has so high an efficiency, and the Professor's talk has made me realize the reason for this in that high stresses can be used.

In comparing the ring spring with the spiral or coil spring, we note that in the ring spring the outer rings are in tension and the inner rings are in compression as the Professor pointed out; while the coil spring is in torsion or shear and the spring can be considered to be stretched out as a long shaft and simply twisted.

The measure of efficiency of these springs is sometimes given as the energy that can be stored in the spring without giving the material a permanent set, measured in inch lbs. per cu. in., which is the same as the Professor has spoken of as foot lbs. per pound of metal.

It might be interesting to you to have some information on the energy stored, or resilience of the principal types of springs, and with your permission I will take a few moments to read from Professor Perry's Applied Mechanics Chapter on Springs, which is one of the best published since the beginning of the Art of Spring Manufacture.

Resilience of Springs

		In. Lbs. per Unit Volume	Ft. Lbs. per Lb. Metal
Simple Compression or Extension as used in Ring Spring.	$1/2\left(\frac{S^2}{E}\right)$	400	118
Bending the maximum stress is reached in every section and the section is rectangular as in beams of uniform strength in well-made carriage springs, and in spiral or coil springs subjected to a torque only.	$1/6\left(\frac{S^2}{E}\right)$	133	36
Simple shearing possible in spiral or coil springs made of thin tubes, circular in section.	$1/2\left(\frac{S^2}{G}\right)$	1000	293
Torsion as in spiral or coil springs of round wire, subjected to axial loads.	$1/4\left(\frac{S^2}{G}\right)$	500	148

For springs of square, oval or rectangular section, the resilience will be somewhat less than the above.

In the above table the stress is taken the same in all cases, namely, 155,000 lbs. per sq. inch, and $E = 30x10^6$ and $G = 12x10^6$.

It is pointed out in the above Chapter on Springs that the maximum elastic shear stress is about one-half the maximum elastic tensile stress. Further it has been shown that for closely wound coil springs the actual stress is higher than ordinarily computed. However, taking the maximum shear stress as one-half the maximum tensile stress, the resilience for the spiral spring will only be one-fourth of the above, namely, 37 ft. lbs. per pound, so that the coil spring is about on a par with the carriage or elliptic springs neglecting the high stresses in the case of the closely wound spring.

From the above it will be noticed that the ring spring is much more efficient than the coil spring, owing to the fact that high stresses can be used and the resilience being proportional to the square of the stresses.

The capacity of the spring is further increased by friction which can be shown to be equal in amount to

$$\frac{\text{Tangent}\quad (A + Q)}{\text{Tangent}\quad A}$$

Where A is the angle of the taper of the spring and Q the friction angle. In the spring described this increase is around 50%.

I thank you for your attention.

PRESIDENT: We thank you, Mr. Clausen. Mr. Canfield, Vice President, Cardwell-Westinghouse Co., may we hear from you?

MR. L. T. CANFIELD: I have been very much interested in what the speaker has said. But I feel that my position as a member of that Committee of the A. R. A. would prevent me from entering into the discussion.

PRESIDENT: Mr. Stucki, may we hear from you on this subject?

MR. A. STUCKI: Generally speaking, I may say that I do not like a meeting to be too harmonious. But I do not want to start an argument with our friend, Professor Endsley, for two reasons, first, we play chess together, and, secondly, he can out-talk me in any argument.

Speaking about springs, Mr. Endsley first mentioned just plain coiled springs. Years ago when with a railroad I was given the job of looking over the springs they had in use. I realized that in order to protect a spring it must be so designed that it becomes solid the very moment its stress reaches that once adapted for spring steel.

In this respect I found many wrong in design. Those which had too much deflection and were forced solid either by shocks or other unforeseen conditions suffered under excessive stress and naturally often failed. Those which had too small a deflection, closed before all the benefit of the strength of the steel was obtained.

By a very careful analysis, a copy of which I yet have in my office, I showed that in order to make it possible to obtain these proper relations in all the springs of a multiple coil, regardless of diameter or size of bars, all such bars must be of the same length.

With this knowledge I was detailed to go over all the springs and see that they conform to the two requirements just mentioned. These springs not only served the respective railroad well, but were also adopted as standard by the then M. C. B. Association. The Class "G" spring mentioned by Mr. Endsley is one of them.

Mr. Endsley mentioned that the formula used is not quite correct. This is true if the tapered portions at top and bottom are considered and the formula, although used for many decades, gives a stress slightly smaller than that obtained if these tapered portions are considered inactive. But, after all, a formula is only a means for comparison and the quality of steel is the real governing portion in determining the ultimate fibre stress required.

I was at one time connected with a company manufacturing springs, hence, well acquainted with the methods and the care used to obtain a uniform output. Everything is done to gauge, even the heating and tempering, and the quenching bath is of a rigid composition, so that there is no possibility of a slip in that direction and still the spring occasionally broke and in every case I investigated I found some imperfections in the steel.

To come back to these ring gears, the Harvey draft spring I knew for many years. I have also seen tests at the Edgewater Steel Company and it is really remarkable how much you can get out of it. The only thing that runs in my mind is how will you control that friction. Friction is the main item to bring up this capacity. When you have, possibly for a very great length of time, this condition of friction of 10%, is it possible that through constant rough usage, out in the weather, on freight cars, etc., that the lubrication will suffer a change which will increase the coefficient of friction and eventually make the springs stick? That is the main question in my mind, Mr. President.

PRESIDENT: Thank you, Mr. Stucki. Mr. O. R. Wikander, of the Edgewater Steel Company is here, and maybe he could answer this question.

MR. O. R. WIKANDER: With the kind permission of Professor Endsley I will try to answer the question about the change in the friction of the ring spring.

In the earliest type of Edgewater draft gear the ring spring was not covered and consequently the lubrication was more affected by the weather than in the present enclosed type of gear. For various reasons it was decided to enclose the spring and the open gears were therefore discarded after about a year's service. One such open gear was however overlooked and was discovered over five years after it had been installed. During its five years' of service the coefficient of friction in this gear

had increased from 8.3% to 9.4% or about 13% of its original value.

The enclosed gears, such as shown in Figure 2, when inspected after four years' of service did not show any increase in friction.

The ring spring draft gear has just been subjected to the A. R. A. Certificate Test. During this test the coefficient of friction at the beginning of the test varied for the various gears from a minimum of 10.6% to a maximum of 10.9%. At the end of the test the coefficient of friction varied from 10.7% to 11.1%, the greatest increase in the coefficient of friction of any gear was thus less than 2% of its original value.

The housing of this gear is dust-proof and when it is removed after the gear has been in service for a few years the outside of the spring is generally covered with a coating of clean grease. Inside the spring, which, as the Professor pointed out, is hermetically sealed the greater part of the lubricant remains practically intact.

I will not enter in other technical details since I feel that the Professor has supplied us with very complete information on the subject.

PRESIDENT: I think we should hear from some of the railroad men. Mr. Moir, Chief Car Inspector of the Pennsylvania Railroad?

MR. W. B. MOIR: I think there is still room for improvement in the present draft gear assemblies as there is still considerable uncontrolled slack action on long trains.

PRESIDENT: Mr. W. Eckels, of the Westinghouse Company, have you anything to add to the discussion?

MR. W. ECKELS: I do not think I have anything to add to what has already been said.

PRESIDENT: Mr. J. Miller, Car Foreman of the Montour Railroad?

MR. J. MILLER: Chairman and Gentlemen, I wish to advise that we have applied two of these draft gears to one of our cars about four years ago and upon examination of same, after eighteen months this car being in service, found that there was only about ⅜-inch friction compression of wear as indicated on the outer pressed housing at that time. The car is still in

service and because I have not seen it since, I cannot give any more information about it. I thank you.

PRESIDENT: Here is one of our old members. We used to hear from him frequently, Mr. J. A. Ralston.

MR. J. A. RALSTON: There are one or two questions I would like to ask the speaker. The first is on the question of lubricating a draft gear. This has not heretofore been done. I would like to know, therefore, what would be the result if a gear of this kind would lose its lubrication. Would there be a tendency for it to stick?

The other question is, what would be the effect on the ring spring should the gear receive eccentric blows?

PROFESSOR ENDSLEY: With regard to the lubrication of the Ring Spring, if it should lose all the lubrication the friction and capacity would go up and there would be danger of sticking. But I personally know of gears that have been in service a good many years that have not stuck.

With regard to off center blows, tests have been made with the blows as much off center as they could get in the car and the gear functioned perfectly.

PRESIDENT: Mr. Hughes, what have you to say?

MR. J. E. HUGHES: I do not believe that we should allow all these mechanical men to get away from this subject. In the first place, Mr. President, ex-presidents usually go west. But we are very glad to have an ex-president with us to present this important subject. I do not see very many rolling stock men around here tonight but in my experience in handling equipment, cars, if we damaged a car in the operating department it was usually charged by the rolling stock department to rough handling on the head end or to the man that rode the car. The car and its pulling appliances, its draft gear and all that, was always in good condition.

Now I had an experience recently in observing a very large locomotive starting a very heavy train. I might say the reason I stopped to look at this train might have been due to the fact that I had not seen a big heavy train for so long that I could not let it pass. However this engineman in my estimation started this train very ordinarily. After the train got in motion, the load was very heavy and all at once I heard a noise of some kind. "There goes a knuckle", I thought, "perhaps it is a draw

head". But very quickly I realized that the air brake was still intact, the train brake did not apply. I wondered that there was not some damage to that train. If the engineer on the head end of that train—and I think Mr. Berg will bear me out in this—had slipped his engine and caught her on sand, as we call it, and broke the train in two it would have been rough handling of course! But what caused this unusual noise toward the rear end of the train that gave the forward portion of that train some acceleration that it did not have in the rear end—and the train went along after that without any trouble?

PRESIDENT: I think Mr. Hughes might tell us what happened. Mr. Gray, of the Bessemer Railroad, have you ever had any experience like Mr. Hughes here?

MR. GUY M. GRAY: I have not, Mr. President.

PRESIDENT: Is there anything further you wish to say, Professor Endsley?

PROFESSOR ENDSLEY: I think not.

PRESIDENT: May we hear from Mr. Dambach?

MR. C. O. DAMBACH: Mr. Chairman and Gentlemen of the Railway Club: I think we may take a great deal of pride in the fact that we have in our membership a man who can spring a paper such as we have listened to tonight without any previous notice. I was very much surprised to see the Professor get so much capacity with so little friction either in the draft gear or the audience. Personally I have enjoyed the paper very much, and I know by the rapt attention he received and also from the discussion that followed that we all have appreciated it. Therefore I move that we extend to Mr. Endsley, and also to Mr. and Mrs. Sheparson for their musical entertainment, a rising vote of thanks.

The motion prevailed by unanimous rising vote.

PRESIDENT: We are going to have a little luncheon immediately after adjournment, to which you are all invited. If there is no further business I will entertain a motion to adjourn.

ON MOTION, Adjourned.

J. D. CONWAY, Secretary.

In Memoriam

SIR HENRY W. THORNTON,

Joined Club April 28, 1927

Died March 14, 1933

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WHITHER IN TRANSPORTATION?

JULIUS H. PARMELEE, Director, Bureau of Railway Economics,
Washington, D. C.

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Reception Committee

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W. P. BUFFINGTON, Traffic Manager, Pittsburgh Coal Co., Pittsburgh, Pa.
T. F. SHERIDAN, Asst. to SMP & SRS., P. & L. E. R. R., McKees Rocks, Pa.
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KARL BERG, Supt. Motive Power, P. & L. E. R. R., McKees Rocks, Pa.
DONALD O. MOORE, Mgr. Traffic Div., Pittsburgh Chamber of Commerce, Pgh., Pa.
G. M. SIXSMITH, Superintendent, Pennsylvania Railroad, Pittsburgh, Pa.

Past Presidents

*J. H. McCONNELL	October 1901, to October, 1903
*L. H. TURNER	November, 1903, to October, 1905
F. H. STARK	November, 1905, to October, 1907
*H. W. WATTS	November, 1907, to April, 1908
*D. J. REDDING	November, 1908, to October, 1910
*F. R. McFEATTERS	November, 1910, to October, 1912
†A. G. MITCHELL	November, 1912, to October, 1914
*F. M. McNULTY	November, 1914, to October, 1916
J. G. CODE	November, 1916, to October, 1917
*D. M. HOWE	November, 1917, to October, 1918
*J. A. SPIELMANN	November, 1918, to October, 1919
H. H. MAXFIELD	November, 1919, to October, 1920
FRANK J. LANAHAN	November, 1920, to October, 1921
SAMUEL LYNN	November, 1921, to October, 1922
D. F. CRAWFORD	November, 1922, to October, 1923
GEO. D. OGDEN	November, 1923, to October, 1924
A. STUCKI	November, 1924, to October, 1925
F. G. MINNICK	November, 1925, to October, 1926
G. W. WILDIN	November, 1926, to October, 1927
E. J. DEVANS	November, 1927, to October, 1928
W. S. McABEE	November, 1928, to October, 1929
E. W. SMITH	November, 1929, to October, 1930
LOUIS E. ENDSLEY	November, 1930, to October, 1931
JOHN E. HUGHES	November, 1931, to October, 1932

†Resigned.
*—Deceased.

Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING
APRIL 27th, 1933.

The meeting was called to order at the Fort Pitt Hotel at 8:00 o'clock, P. M., with President F. I. Snyder in the chair.

Registered attendance, 194, as follows:

MEMBERS

Ament, F. C.
Anderson, Burt T.
Batchelar, E. C.
Berg, Karl
Bernoulli, W. H.
Bradley, W. C.
Brown, E. L.
Callahan, F. J.
Campbell, J. E.
Campbell, J. T.
Carlson, L. E.
Carr, T. W.
Clark, C. C.
Conway, J. D.
Coulter, A. F.
Crawford, A. B.
Crenner, J. A.
Dambach, C. O.
Davies, James
Davis, Charles S.
Dempsey, P. W.
Dickinson, T. R.
Diven, J. B.
Doyle, T. E.
Edwards, C. H.
Emsheimer, Louis
En Dean J. F.
Endsley, Prof. Louis E.
Fink, P. J.
Fisher, John J.
Flinn, R. H.
Frauenheim, A. M.
Freshwater, F. H.
Furch, George J.
Gilg, Henry F.
Gillespie, J. Porter
Goda, P. H.
Grieve, Robert E.
Haller, C. T.
Harman, H. H.
Hauser, G. Bates
Honsberger, G. W.
Hoover, J. W.
Huff, A. B.
Huston, F. T.
Johnston, Harvey F.
Jones, H. W.
Kapp, A. C.
Kellenberger, K. E.
Keller, R. E.
Kelly, L. J.
Kerr, C. R.
Krick, F. H.
Kummer, Joseph H.
Kusick, Harry F.
Lanahan, Frank J.
Landis, William C.
Layng, F. R.
Leban, J. L.
Leet, C. S.
Long, R. M.
Longdon, C. V.
Lynn, Samuel
Lynn, William
Maliphant, C. W.
Manson, A. J.
Meily, R. P.
Millar, C. W.
Mills, C. C.
Misner, George W.
Mitchell, F. K.
Mitchell, W. S.
Moir, W. B.
Molyneaux, Dawes S.
Montague, C. F.
Morgan, A. L.
Morgan, Homer C.
Moses, G. L.
Murray, S.
Mussey, D. S.

Myers, B. E.
McCloskey, J. C.
McFetridge, W. S.
McKinley, John T.
McLaughlin, H. B.
McNamee, W.
Nagel, James
Nash, R. L.
Newell, J. P., Jr.
Orbin, Joseph N.
Orchard, Charles
O'Sullivan, J. J.
Painter, Joseph
Palmer, E. A.
Pollock, J. H.
Pringle, H. C.
Redding, P. E.
Renshaw, W. B.
Richardson, H. R.
Robinson, R. L.
Rudd, W. B.
Rutter, H. E.
Ryan, Frank J.
Schaller, A. J.
Schmitt, Raymond F.
Schrader, A. P.
Seiss, W. C.
Sekera, C. J.
Severn, A. B.
Sheridan, Thomas F.
Simons, Philip
Smith, H. K.
Snyder, F. I.
Stamets, William K.
Stephen, James
Stevens, L. V.
Stoffregen, Louis E.
Sullivan, P. W.
Sutherland, Lloyd
Thomas, Theodore T.
Tipton, G. M.
Trax, L. R.
Triem, W. R.
Van Blarcom, W. C.
Walther, G. C.
Waterman, E. H.
Watt, Herbert J.
West, Troy
Wheeler, C. M.
Wikander, O. R.
Wildin, G. W.
Winslow, S. H.
Wright, Edward W.
Wright, J. B.
Wurts, T. C.
Young F. C.

VISITORS

Beiger, John S.
Bercaw, C. A.
Binkerd, Robert S.
Bone, H. L.
Borell, E. A.
Burns, Robert C.
Cable, T. H.
Campbell, C. A.
Campbell, J. D.
Colbaugh, George D.
Combs, T. A.
Cornell, J. Richard
Cornell, L. E.
Cross, F. H.
Curcio, H.
Dean, John S.
Deems, E. G.
Dickinson, Mary E.
Dickinson, Mrs. T. R.
Dobson, J. V.
Dunham, C. W.
Elmer, William
Fowler, William E., Jr.
Gavin, V. F.
Gerson, Ernest
Helmstetter, C. A.
Howard, N. D.
James, J. H.
Kaine, T. F.
Kerr, Charles
Kester, W. B.
Kohl, J. C.
Kruse, V. L.
Lesko, A.
Lewis, Ralph S.
Lewis, S. B.
Lott, George
Mitchell, E. W.
Mock, J. P.
Petersen, W. C.

Pyle, Robert H.
Rose, J. W.
Ross, B. J.
Schadt, A. D.
Schmitt, Elmer M.
Sheparson, F. C.
Smith, Sion B.
Stanton, Prof. Charles B.
Stevenson, L. N.
Stotler, H. K., Jr.
Tomlinson, Charles H.
Travers, John
Tyson, Albert
Vollmer, Paul F.
Wallace, H. A.
Wentworth, A. L.
Whitney, E. F.
Wright, Robert M.

PRESIDENT: Before proceeding with the regular business program of the evening, we will be favored by Miss Mary E. Dickinson, Soprano Soloist, with a few selections of songs and will be accompanied on the piano by her mother, Mrs. T. R. Dickinson. Miss Dickinson is the daughter of Mr. T. R. Dickinson, connected with the Purchasing Department of the Bessemer & Lake Erie Railroad. Miss Dickinson then rendered in a very artistic manner several beautiful songs.

PRESIDENT: We appreciate very much Miss Dickinson and Mrs. Dickinson coming here this evening and entertaining us so delightfully.

The printed Proceedings of the last meeting have been distributed and we will therefore dispense with the reading of the minutes of the last meeting.

The registration cards give us a complete record of the attendance, so we may dispense with the roll call.

The Secretary will read to you the list of applications for membership.

SECRETARY: We have the following proposals for membership:

Bone, H. L., General Mechanical Engineer, Union Switch & Signal Company, 1025 Macon Avenue, Pittsburgh, Pa. Recommended by L. F. Howard.

Gleeson, Harry L., Sales Agent, The Lorain Steel Company, 318 Frick Building, Pittsburgh, Pa. Recommended by F. I. Snyder.

Hilbert, Rudolph F., Engineer, Fort Pitt Spring Company, 833 Neely Heights, Coraopolis, Pa. Recommended by Dawes S. Molyneaux.

McAndrew, R. E., General Storekeeper, Bessemer & Lake Erie Railroad Company, Greenville, Pa. Recommended by T. R. Dickinson.

PRESIDENT: These proposals will be referred to the Executive Committee in due course, and upon approval by that Committee the gentlemen will become members without further action.

SECRETARY: Since our last meeting we have received information of the death of Mr. A. B. White, who for many years was Superintendent of the Buffalo, Rochester & Pittsburgh Railway Company, located at Punxsutawney, Pa. Mr. White, I feel, was known to many of you as he attended many of our meetings until such time as he became ill. It was my pleasure to know him intimately and he was a man of high character and ability and readily made friends. He became a member of our Club October 23, 1919, and passed away April 19, 1933.

PRESIDENT: An appropriate memorial minute will appear in the next issue of the Proceedings.

Is there any further business to be taken up at this time? If not, we will proceed to the address of the evening. We are very fortunate in having with us tonight to address us a man whom we all know, if not personally at least by reputation and by reading his excellent reviews and analysis of railway operations, Dr. Julius H. Parmelee, Director of the Bureau of Railway Economics at Washington, D. C. He is one of the foremost railroad statisticians and analysts of the country. He has taken time out of a very busy life to come over here and address us. He has some very special and important work engaging his attention just at the present time and we feel very much gratified that he has come to us under the circumstances.

There is a great question in the minds of every one here tonight, railroad men and others, as to what the next month or two will bring forth pertaining to the railroads. The railroads are in a crisis today and the public prints are very full of plans and speculations as to what is just ahead for them. Dr. Parmelee's subject is "Whither in Transportation." He will give us some interesting light on this very live, up to date question.

WHITHER IN TRANSPORTATION?

JULIUS H. PARMELEE, Director, Bureau of Railway Economics, Washington, D. C.

Once a year, at the approach of Christmas Day, I take the Christmas Carol of Charles Dickens off my library shelves, and again call to mind the adventures of Ebenezer Scrooge with the

Ghost of Christmas Past, the Ghost of Christmas Present, and the Ghost of Christmas Yet to Come. That allegorical method of combining both history and prophecy—what in modern business language we call analysis and forecast—has become classic, and I shall attempt it tonight in my discussion of transportation past, present, and future. How successful the attempt at analysis will be, it rests with you to say; how accurate the attempt at a forecast, only the events of the future will disclose. And when those events have transpired, the memory of this my essay into the realm of prophecy will doubtless have faded from your minds. The success of a forecaster depends, you will agree, rather on the extent to which his forecasts are forgotten than on the degree to which he actually rings the bell.

TRANSPORTATION PAST

It would be impossible to cover, except in the sketchiest way, the past, present and future of transport in the United States. Let us take a flying view of the past and present, then devote ourselves to what interests us most particularly at this time, the possibilities of the future.

I dreamed a dream, in which the transport developments of the post war period seemed to pass swiftly in review before my eyes. The panorama was one that has become familiar to all of us. I saw the railways, in particular, emerge from the war period in serious condition, meet and grapple with many physical and financial difficulties. Then in 1923 they adopted a program of rehabilitation and of operating efficiency that, successfully prosecuted, carried them to a peak of performance and of financial reward. In the year 1926, you will recall, the total revenues of the railway industry were the greatest of any year in its history. The net income of the railways reached its peak in 1929, three years later, and while the rate of return in that year was below that contemplated by law, it did provide a considerable margin over fixed charges. In any case, we now look back at the results of 1929, and wonder when we shall return to that level.

You will further recall that the railways, during the four years from the beginning of 1926 to the end of 1929, reached a high plateau of freight traffic. The ton-mileage of each one of those four years was greater than in any year prior to 1926 and, I may add, than in any year since 1929.

Then struck the whirlwind, in the form of economic depression, which year by year drew railway traffic, revenues, and

net income down to progressively lower levels in 1930, 1931, and 1932.

But this was not all. During the same post war period, competition in the field of transport grew apace, with resulting effects on the American railway. With the renaissance of waterways, aided by liberal subsidies from the government, traffic by water became increasingly important during this period. Highway transport, particularly the haulage of goods by motor truck, became a real menace to rail freight service, was subject to no Federal regulation whatever, and was under state control to a lesser degree than had been the case with railway transport for many years. Air transport, with government aid, was extended to transcontinental services, and then to intercontinental.

TRANSPORTATION PRESENT

So the panorama of the recent past unfolded itself. I then turned my eyes to the present, that is, the developments of the transport industry since the beginning of 1932.

This review of the last fifteen months brought out many things of vital import for today and for tomorrow.

Rail traffic and earnings have continued to decline, with a disastrous effect on net income, which in the great majority of companies disappeared and was replaced instead by deficits.

At the beginning of 1932, the Interstate Commerce Commission authorized some freight rate increases, which were temporary in nature and restricted in extent. The revenues derived from these increases were pooled by voluntary agreement of the railways themselves in a loan fund, administered by the Railroad Credit Corporation. While the effect of this assistance was smaller than had been expected, because traffic continued to decline, yet it proved to be one of the factors that kept the rail industry relatively solvent.

At the beginning of 1932, the government established the Reconstruction Finance Corporation, which loaned government funds to railways, financial institutions, and local governments. Many railway companies availed themselves of these loans, and utilized them primarily to meet maturing obligations and bond interest, although in some cases they found it necessary to spend the proceeds for taxes, and even for operating expenses that had not been currently earned.

Again at the beginning of 1932, railway employees agreed to a temporary deduction of ten per cent from their pay checks,

an agreement that is still in force. Many of the officers and supervisory forces have received salary reductions far in excess of ten per cent.

For nearly four years, the railways have been engaged in the battle with depression. This battle has now resolved itself largely into a reduction of all expenditures to levels that can be met from dwindling revenues and that yet will assure continued adequacy and safety of transportation service. The battle has been a hard one, has demanded the most stringest economy, but has been successfully conducted by the great majority of companies.

In fact, this battle has become the outstanding achievement of the railways within the past year. As the Interstate Commerce Commission put it in their latest annual report to Congress:

> "The railroads have been in general surprisingly successful in reducing their operating expenses in a ratio reasonably close to the reduction in operating revenues."

At the same time, competition from other agencies of transport, especially the motor truck on the highway, has grown more rather than less intense. In the necessity many shippers have been under to economize, they have turned to transportation service that may seem cheaper than rail, but in the long run may prove a costly form of experimentation.

So I see the rail carriers today, still fighting declining receipts, still economizing, still maintaining service at satisfactory levels, still meeting their competitors on a lower basis of rates, still keeping up their courage, still joining the rest of industry in looking for the upward turn in economic activity, still praying for that increase in carloadings that shall give them a breathing spell in this battle against the giant foe of depression.

We may describe the situation by paraphrasing a slogan made notable during the war: The rail industry may be down, but it is not yet, or ever, through.

Or, in more classic strain, we may paraphrase that immortal couplet of William E. Henley, and say of the railway managements:

> "In the fell clutch of circumstance
> They have not winced nor cried aloud,
> Beneath the bludgeonings of chance
> Their heads are bloody but unbowed."

TRANSPORTATION YET TO COME

I dreamed another dream, in which the future of American transportation seemed to unroll before my eyes. In fact, I was in the year 1950, and was looking back at the panorama of events from 1933 to that date. The panorama had in it some confused spots and there were factors that to our present eyes would appear to be radical, dangerous, and impossible. Yet the American nation had struggled through, and transportation as well as other economic activities survived.

Let us review this panorama together. Remember that we are now looking back to 1933. So looking back, it was manifest that the most hopeful element in that year was the intelligent and sympathetic interest the American people were beginning to give to transportation and its future. This attention to transport matters was founded on the realization that the public interest and the interest of railway transport were one and inseparable, and that what affected one adversely was a serious blow at the other.

The Interstate Commerce Commission had sensed this hopeful change in the state of the public mind when they said in their annual report for 1932:

> "More or less aimless concern over the future of the railroads is rapidly being replaced by intensive study directed toward ways and means of improving the situation."

Again, the public in 1933 was comforting itself with the thought that the United States had passed through several depressions in its history, and had always emerged stronger in every way than before. The pessimists scoffed at this notion, just as the optimists in early 1929 ridiculed the idea that prosperity might not continue in an ever upward spiral. Both groups were of course wrong, the optimists of 1929 and the pessimists of 1933. But the pessimism continued nevertheless.

I found one such long-faced Jeremiah in 1933 who fastened me with his glittering eye, and insisted on reading aloud to me an article in the current newspaper. Part of it ran as follows:

> "In times like these, we find ourselves in the midst of a serious financial and industrial crisis. It just seems inconceivable that conditions can ever right themselves enough to have prosperous times in the country again. Trade and industry throughout the land are disorganized. Banks by the hundreds have failed. Securities

have fallen to one-half or even one-quarter of their former value.

The problem of unemployment has become general and in all large cities special committees have been organized to provide food and clothing for the poor and unemployed.

The lessening demand for wheat exported to Europe has caused American wheat to sell in the West for less than 50 cents a bushel. Extensive competition, lowering prices and unwise speculation have brought about a crisis. The renewal of confidence and the allaying of violent fear in the minds of the people, which will allow for active buying, rather than money hoarding, must precede business recovery."

Sounds familiar, doesn't it? Every word unquestionably applied to conditions as they existed in 1933. Jeremiah smiled at me triumphantly when he had finished, but his smile faded somewhat when I pointed out to him a note at the bottom of the article. The note stated that the item was quoted verbatim from an address by Daniel Webster in Detroit, Michigan, delivered in the year 1837.

Returning to 1933, other hopeful signs were the transportation studies made in that year by the National Transportation Committee, by the Joint Committee of Railroads and Highway Users, and by government officials and advisers. Their effort was not only to find a way out for the railways, but to effect such a co-ordination of the several transport agencies as to preserve their best features and at the same time promote the public interest . While some of the recommendations resulting from these studies were not and could not be adopted, they supplied food for thought, and undoubtedly aided in the effort to work out practical solutions.

Among other things, the American people in 1933 were beginning to realize that the effort to restrict production, especially in the case of farm commodities, was an approach from the wrong end. Rather was it the solution to increase the effective demand for goods the world over, and so absorb the growing production. While some nations, like the American, were overstocked with food, raw materials, and manufactured products, other nations, like the Chinese, were undernourished and poorly supplied with the comforts of living. In coming to this realization, the minds of thoughtful people in 1933 were

greatly impressed by this sentence from a popular book by a popular author, where he said:

> "The limiting of production was a device so pathetic that future generations were to look back on it as the last resource of men who were scarcely sane."

This realization spread to other nations, and led eventually to a series of agreements among the nations, whereby they all produced more goods than they themselves needed, and traded the surplus to other nations in exchange for *their* surplus. Many adjustments and mutual concessions among the nations of the world were necessary, trade and finance barriers were lowered or abolished, but when all this had been done, it was surprising how quickly the supposedly insuperable economic difficulties of the world faded away. No longer was overproduction a scourge, but a blessing, which gave every worker a job, higher wages and purchasing power, and raised standards of living in all countries. In fact, the word "overproduction" no longer applied, because supply and demand moved into balance, and the nightmare of surplus stocks largely disappeared.

Transportation agencies shared, of course, in this movement. Instead of transport finding itself with an excess of facilities, as in 1933, the rise in economic activity set locomotive wheels to turning, and many of the difficulties encountered by the railways during the depression automatically disappeared. The railways' slogan of 1933, "All we need is traffic," was abundantly justified by subsequent events.

But before this happy solution of the world's troubles was fully worked out, certain transition measures were adopted by the United States in 1933 and 1934. The much-discussed creation of the post of Federal co-ordinator for the railway industry brought improvement in railway performance, but it was notable that the improvement was made largely by the railways themselves. The impetus supplied by the co-ordinator legislation, together with the relaxation of certain restrictive legislation that had therefore held them back from well defined forward steps, led to co-operative progress along lines not previously possible. These restrictions were the result of anti-trust laws, state regulation, accounting rules, and charter and legislative provisions. All this proved what had long been contended, that the railway industry needed not so much additional control and regimentation, but freedom to work out its salvation according to the best judgment of its own leaders.

Several impractical provisions of regulatory law, such as the recapture clause of the Transportation Act of 1920, were repealed outright. Other provisions were modernized and modified, in sympathy with the newly developing idea that economic barriers should be lowered rather than raised.

At the same time, other agencies of transport were subjected to Federal regulation, so as to place all agencies on an equal competitive basis. This led to greater coordination among the several agencies than had formerly been possible. So was another forward step taken, which everyone had known for years should be taken, but which no one knew how to effectuate. Another of those things that, when once accomplished, we wonder why it had not been done years before. Paraphrasing a pungent sentence from Dickens, the nation, having effected logical reforms in transport legislation, "was in a state of perpetual astonishment at finding itself so reasonable."

With all these changes, the Interstate Commerce Commission was retained as the central unit of Federal regulation. Its functions were limited in some directions and extended in others, but the chief purpose of the new legislation was to relieve the Commission of many petty details of responsibility, and to concentrate its energies on those broader aspects of regulation which related themselves to public policy: development of the several types of transportation, rates and costs, finances, efficiency in service, and the like.

In closing, I take considerable satisfaction in calling to your attention the fact that although a statistician, I have quoted you no transportation statistics in this review of transportation past and present; and that although an economist, I have not once used those two favorite words of modern economists: "railway problem".

May I quote as my final word these recent words of Bruce Barton:

> "All the pioneers, all the explorers and leaders and builders have gone out not knowing whither they went. It isn't necessary to know the end. If the whole path ahead were clear, there would be no adventure."

Gentlemen, we are on our way to important developments and changes in transportation. We know not exactly how or whither we go, but that is less important than our readiness to adapt ourselves to the future, come what may. Let us believe that we shall emerge, and soon, from the throes of depression, and that under such conditions we shall again need our rail-

ways and other transport agencies, to carry on in future, as in the past, for the welfare of our nation.

PRESIDENT: Gentlemen, the subject is now before you for discussion. I am sure there is material for a very full and live discussion.

MR. CHARLES ORCHARD: Will you tell us how some of the proposed consolidations of railroads that have been talked of in the past few years will be affected by the new legislation now under consideration at Washington?

DR. PARMELEE: It is my opinion that revision of the Interstate Commerce Act will provide in fuller degree for consolidations, but that the actual problem of consolidation will be in the background for the next few years. Economies can be and I think will be carried out without the necessity of consolidation, and when many of the economies which are of the same nature as those which are brought about by consolidation shall have been made effective, it will be a simpler and easier task to consolidate. Though it is true that some radical consolidation proposals have been made in Washington, it is my opinion that we will not have compulsory, or even voluntary, consolidation for several years on any large scale.

MR. BURT T. ANDERSON: What is likely to be the scope of the Federal coordinator's activities?

DR. PARMELEE: It seems clear that the legislation which is likely to pass will be general in its terms, will give the Federal coordinator wide powers to suggest, first, and next to order, possibly, certain changes regardless of existing anti-trust or other legislation. Whether his orders shall be subject to review by the Interstate Commerce Commission seems to be still under discussion. I still believe, as I said a moment ago, that the chief benefit of that legislation will lie not so much in the power actually given the coordinator himself as in the relaxation of certain restrictions on the railroads which will permit them to carry out their own plans for economies.

MR. HENRY F. GILG: Dr. Parmelee's talk is very interesting, and particularly so to a man who was a kid in the panic of 1873. It was several years after that panic, perhaps along about the Centennial year, that I heard Daniel Webster's remarks quoted, the same then as Dr. Parmelee quoted them today. It is still more interesting because half a century ago

the political economy mentor of my adolescent years told me the dangers into which this country would be driven by subsidies. Every one who can read knows what has happened. And that is one of the principal troubles with the railroads today. I know that they would have lost traffic, as they did after the panic of 1873 and subsequent panics, but this was accentuated by the development of the rivers and also by the bus transportation.

Now, it was told me prior to the enactment of the Sherman anti-trust law and the Interstate Commerce law that both of them were uneconomic and would cause trouble and distress and the day would come when the country would have to repeal them. Dr. Parmelee tells you tonight that that is being considered. We know it has been because there has been considerable discussion about it recently. Now the Interstate Commerce law has been in control of men—we know during the war period it was very disastrous. The problem in my mind is whether that kind of coordination or that kind of incorporation of the railroads might not come back, might not be repeated. That is the thing which I fear.

Now I want to ask Dr. Parmelee a question. Why was the rate case opened by the Interstate Commerce Commission?

DR. PARMELEE: Two sets of policies are going on in Washington at the present time, and we can only speculate as to what the ultimate results will be. Which of these two policies, the policy of deflation and that of inflation, will win out in the long run, it is difficult to say. The policy of deflation is that adopted by the present administration, and to some extent by the last one, in the effort to reduce government costs, in the considerable discussion of the deflation of the capital structure of the railroads, the deflation of farm mortgages, of debts of various kinds, etc. That policy might lead to a reduction in freight rates and the costs that enter into the cost of production and distribution of products. In my opinion, the Interstate Commerce Commission initiated the rate reduction case, not so much because of the demand from shippers as because of the fact that it conceived it to be an element in the general policy of deflation. The difficulty which the Commission is now under, and I think will be more so as the case goes on, lies in the fact that a reduction of freight rates as an element of deflation may come up against what I have referred to as the contrary policy of inflation. As prices rise under the

inflationary policy, wages may rise, and as the demand is made for their increase it is clear that freight rate reductions can hardly be made.

My answer to your question is that I believe the proposal to reduce rates is a step in the general deflation policy.

MR. A. P. SCHRADER: In your opinion how far do you think regulation will be necessary?

DR. PARMELEE: I do not quite understand your question.

MR. SCHRADER: To what extent, to what extremes of regulation it will be necessary to go?

DR. PARMELEE: That is a pretty large subject and I am afraid it is too late in the evening to start it.

I might answer by saying that in general Federal regulation of transportation must continue. I doubt if there is any railroad executive—there may be a few, but extremely few—who would go back to the old unregulated basis that existed prior to the original Interstate Commerce Act. Some regulation of transportation, and I mean all forms of transportation, is in my opinion necessary and must continue. But to enter into a discussion of how far that regulation shall go, how it shall be correlated, where regulation will stop, and who shall exercise it, would be by far too large a subject to attempt this evening.

MR. K. E. KELLENBERGER: What are the prospects for regulation of competing types of transportation?

DR. PARMELEE: I think all transportation agencies will be brought under regulation before the end of 1934, and that means Federal regulation in some form of our highway transportation agencies, a greater amount of regulation of water carriers, the last Congress having made a step forward in that direction, and some further possible regulation of air transportation.

MR. GILG: May I submit a few more remarks? I might possibly answer this gentleman over here. If we get a man for coordinator who knows what a railroad is, we will have excellent results. Mr. Theodore Dreiser said last year that he could take a man from college and in three weeks make a railroad executive out of him. If we get that kind, we are going to have h——.

MR. WILLIAM ELMER: What would you do with this coordinator in order to permit these reductions in operating expense? For instance if he sees that there are too many trains running between Twin Cities and Chicago and he proposes to consolidate some of them and take off a few trains, he runs up immediately against the labor situation which will not permit any reduction in time. Just what is open to him by which he can make any decided economies?

DR. PARMELEE: It is generally supposed that the coordinator will work in co-operation with committees of the railroad executives themselves, of which there will probably be three, one in each of the three districts of the United States, and composed perhaps of five members each. Much will depend, answering your question, on the character of the coordinator and the ability he shows to work diplomatically and effectively with these committees of executives. Much will depend also upon his ability to work effectively with railway representatives and organizations. He will have many difficult problems and if he be wise he will first exhaust all possible methods of argumentation and effort to bring about voluntary action on the part of the railroads and on the part of labor. If he fails, theoretically he can order the changes without voluntary agreement. In the last analysis I believe the success or failure of the scheme will depend largely on the character of the coordinator himself.

PRESIDENT: We have with us Mr. N. D. Howard, Editor of the Railway Age. We would be glad to hear a word from him.

MR. N. D. HOWARD: It is a pleasure to be here and I am much encouraged by the thoughts Dr. Parmelee has expressed. We are trying in the Railway Age to carry on and help the railroads in their difficulties at the present time, and I think our efforts are being appreciated. In fact, only yesterday the chief maintenance officers of two different roads expressed their gratitude for what the Railway Age is doing. I know that much of what Dr. Parmelee has said tonight will be carried to railroads all over the country through our pages. It is a pleasure to be here. I highly appreciate the hospitality that has been extended to me.

PRESIDENT: Mr. R. S. Binkerd, Vice President of the Baldwin Locomotive Works, have you anything to say on this subject?

MR. ROBERT S. BINKERD: By a most curious coincidence, the same time Dr. Parmelee had his dream I had one too. Like him, I also was in the year 1950 and—looking back—saw unrolled before me all that had happened since 1933. I saw practically everything that he did; the return of million car weeks of railroad traffic; the change in public attitude; the relaxation of railroad regulation and the inclusion of other forms of transportation under public control. But I also saw some things which he seems to have missed.

For instance, I saw that the railroad men had taken hundreds of millions of dollars out of the property investment accounts of these railroads that had been tied up in unnecessary shops and machinery and manufacturing on which they had been losing taxes and interest and overhead and insurance for many, many years. They had shrunk these things out of their property investment account because they had been unproductive and they had finally concluded that the business of railroad men was to produce transportation.

I also noticed that there were not nearly as many roundhouses as there had been in 1933, nor nearly as many locomotives. The figure for the locomotive inventory in my dream was a little hazy, but apparently was somewhere between 30,000 and 35,000 locomotives. Yet these locomotives were turning out about as many miles per annum as they did before 1929. But since there were so many less locomotives railroad managers were running the legs off of them and constantly buying new ones and scrapping old ones.

Of course you will understand that I am not talking shop!

But the most interesting thing about my dream was that this constant intake of new locomotives was being accomplished without any addition to outstanding railroad capital. In 1950 the railroad managers were not worrying at what rate of interest they could sell equipment trust securities. The reason for this was that they had set about resolutely to provide depreciation rates on all forms of railroad property which was subject to depreciation and obsolescence. They had established these rates at a point sufficient to actually keep the property perpetually renewed; and instead of having these depreciation accruals used for non-productive property investments for which nobody else would provide new capital, these depreciation accruals were used year after year to purchase new cars and locomotives and to provide new facilities which paid for themselves within a few years. And so there was no longer any question about the

ability of the railroads to provide themselves, in bad times as well as good, with all those things which would help them to produce efficient and economical operation under any conditions.

PRESIDENT: Professor Charles B. Stanton, of the Carnegie Institute of Technology, may we hear from you?

PROF. CHARLES B. STANTON: I came here tonight to listen and to be instructed and I do not know that I have anything to say. I might O.K. one thing that developed this evening, a thing we try to impress on our students, that is that they cannot become finished railroad men in six weeks.

PRESIDENT: We would be glad to hear from Mr. Ralph S. Lewis, of the Bureau of Traffic of the city of Pittsburgh, on this subject from the public point of view.

MR. RALPH S. LEWIS: I am more familiar with the highway transportation problem than with the railroad end of it. I noticed the speaker made reference to highway transport regulation within the next year and a half. I am wondering if that regulation will extend to intrastate highway transportation as well as interstate.

DR. PARMELEE: No, my reference was entirely to interstate regulation by the Interstate Commerce Commission, or some other body that may be selected by the Federal Government to regulate highway transportation, both truck and bus. I had no reference to intrastate regulation, which of course is handled by the states themselves according to their own best judgment. The plan suggested by the Interstate Commerce Commission is that a considerable amount of control be given the Commission over interstate motor bus operation, and at the beginning a rather moderate and general supervision over interstate motor truck transportation. In other words, try out by degrees the regulation of the motor truck.

PRESIDENT: We have not heard from a railroad man as yet. I wonder if Mr. Flinn of the Pennsylvania Railroad will give us something from the point of view of the railroad man.

MR. R. FLINN: I have been listening to the dream of my friend over here. There is another thing that Dr. Parmelee omitted from his dream that I took with a considerable degree of satisfaction. I judge from what he said that he does not think there is much probability of government ownership. That

has been discussed a great deal in certain sections of the press. I wonder if you would care to give us your thought on that particular phase of the question.

DR. PARMELEE: It is a curious thing that at the present time two extremes of thought are probably nearer together on this question of government ownership than ever before, and perhaps than they ever will be the case again. By extremes of thought I mean those groups of our society which call themselves liberal or radical or socialist or what not on the one extreme, and the most conservative group at the other extreme, that is, the investors or those who represent investors, such as insurance companies, savings banks, investment bankers and organizations of that type. Unfortunately the latter class, the conservative group, in some cases at least are thinking more in terms of the immediate saving of their own investments or the investments of those whom they represent than they are of the future welfare of the country. So much for the desires of these two groups.

It is my opinion, and it is a considered opinion, that while there is some danger of government operation, it is not so great as it was in 1919. You will recall that the Director General of Railroads, Mr. McAdoo, pleaded with Congress at that time that the period of government control be continued for a period of five years longer. If that had been done, if his plea had been accepted and carried out by Congress, I believe we would be in government ownership and control today. The danger then was a very real one. There is some danger today but the danger will be lessened to the extent by which the return of traffic comes and comes quickly. The railroads today have not borrowed as much money from the government through the R. F. C. as it borrowed under the Transportation Act, and their loans from the Transportation Act as you know have been almost entirely repaid with 6% interest. It is clear that the railroads with a return of traffic and earnings will be as able to repay to the government the present R. F. C. loans as they were to repay the 1920 and 1921 loans several years ago. That condition which I hope and believe will return, improvement in the financial position of the railroads, will enable them to repay the government within a few years and in that way to obviate the immediate fear or prospect of government ownership.

PRESIDENT: Are there any other questions? Does any one wish to comment further on the subject? I notice a great

many visitors among us tonight and I want to welcome them to this meeting and to all meetings of the Club. And I would also extend an invitation to join the Club. The dues are $3.00 a year. We have nine stated monthly meetings similar to this one, taking a three months vacation in the summer time. The proceedings of each meeting are printed and distributed to the members. It is a very large $3.00 worth and if any of you are interested either now or later any member of the Club will secure an application blank for your signature and pass it on to the Secretary. After adjournment there has been prepared a luncheon, which is also a custom of the Club.

Mr. Dambach, have you anything to add?

MR. C. O. DAMBACH: Mr. Chairman and fellow Members: All of us who have been fortunate enough to hear Dr. Parmelee before various meetings of the American Railway Association meetings on transportation and economic matters were sure of a very entertaining and instructive paper tonight. The rapt attention he received from the audience and the lively discussion following the reading of the paper indicate our appreciation. And in moving a vote of thanks to Dr. Parmelee for his very able and interesting paper, I would include also Mr. R. H. Aishton for his very gracious message to the Railway Club of Pittsburgh.

The motion prevailed by unanimous rising vote. The meeting was thereupon adjourned.

J. D. CONWAY, Secretary.

In Memoriam

A. B. WHITE

Joined Club October 23, 1919

Died April 19, 1933

OFFICIAL PROCEEDINGS

RAILWAY CLUB OF PITTSBURGH

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GENERAL COMMENTS ON AIR CONDITIONING

By S. M. KINTNER, Vice President, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

AIR CONDITIONING OF RAILWAY PASSENGER CARS

By CHARLES KERR, JR., Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

OFFICIAL PROCEEDINGS

OF

The Railway Club of Pittsburgh

Organized October 18, 1901

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Meetings held fourth Thursday of each month except June, July and August.

PROCEEDINGS OF MEETING

MAY 25th, 1933

Prior to calling to order, the Club was delightfully entertained by the Westinghouse Club Quartette in a select program of vocal music.

The meeting was called to order by the Secretary at 8 o'clock, P. M.

Registered attendance, 156, as follows:

MEMBERS

Allen, Harvey
Ament, F. C.
Anderson, Burt T.
Anger, J. G.
Babcock, F. H.
Bald, E. J.
Beam, E. J.
Berg, Karl
Bone, H. L.
Buffington, W. P.
Burgham, M. L.
Carlson, L. E.
Christy, F. X.
Clark, C. C.
Conway, J. D.
Cutler, D. E.
Davis, Charles S.
Eagan, D. F.
Emsheimer, Louis
Endsley, Prof. Louis E.
Fieldson, P. H.
Frauenheim, A. M.
Frauenheim, P. H.
Fults, J. H.
Furch, G. J.
Gilg, Henry F.
Goda, P. H.
Goodman, O. F.
Haller, C. T.
Hansen, William C.
Hauser, G. Bates
Hilstrom, A. V.
Holmes, E. H.
Honsberger, G. W.
Huff, A. B.
Hughes, John E.
Huston, F. T.
Irwin, R. D.
Jones, R. Clifford, Jr.
Kapp, A. C.
Keller, R. E.
Kraus, Raymond E.
Kruse, J. F. W.
Kohl, H. J.
Kummer, Joseph H.
Lang, W. C.
Logan, J. W., Jr.
Long, R. M.
Long, Walter
Longdon, C. V.
Lundeen, Carl J.
Lynn, Samuel
Lynn, William
MacDonald, William C.
Maliphant, C. W.
Manson, A. J.
Masterman, T. W.
Matthews, R. J.
Meily, R. P.
Meyers, William F.
Michaels, J. H.
Misner, George W.
Mitchell, W. S.
Morgan, Homer C.
Moses, G. L.
Murray, Stewart
Mussey, D. S.
McKinley, John F.
McKinnon, H. D.
McLean, J. L.
Nash, R. L.
Orchard, Charles

O'Sullivan, J. J.
Pugh, A. J.
Rauschart, E. A.
Redding, P. E.
Rizzo, C. M.
Robinson, R. L.
Schmitt, Raymond F.
Seiss, W. C.
Severn, A. B.
Sheridan, Thomas F.
Smith, J. Frank
Stamets, William K.
Stucki, A.
Thomas, Theodore
Trax, Louis R.
Tucker, John L.
Van Blarcom, W. C.
Weaver, W. Frank
Wheeler, C. M.
Wikander, Oscar R.
Wildin, G. W.
Winslow, S. H.
Wright, J. B.
Wright, O. L.
Wurts, T. C.
Wynne, F. E.
Yarnall, Jesse
Young, F. C.

VISITORS

Badger, C. E.
Balph, M. Z.
Baugher, J. W.
Baughman, G. W.
Bergan, R. P.
Brecht, W. A.
Brown, R. J.
Cable, T. H.
Candee, A. H.
Canon, H. A.
Chalfant, James G.
Dunahm, C. W.
Elder, Earle F.
Emery, Frank
Fowler, W. E., Jr.
Frack, William, Jr.
Furch, G. J., Jr.
Goodwin, A. E.
Goodwin, W. C.
Green, K. W.
Hayes, George W.
Hewlett, H. D.
Heinsberg, A. H.
Hess, Charles A.
Horner, W. M. C.
Irving, T. P.
Jados, Walter J.
Jones, M. F.
Jablow, Charles
Kelly, Ralph
Kerr, Charles, Jr.
Kester, M. B.
King, W. R.
Kintner, S. M.
Koch, P. R.
Lewis, S. B.
Lundeen, R. G.
MacDonald, D. J.
Meyers, Gerald F.
Meyers, William B.
Mock, J. C.
Moore, H. Lee
Rickabaugh, C. A.
Kentlein, John
Sauer, L. E.
Smith, Lewis R.
Smith, Sion B.
Storall, J. W.
Stevenson, L. N.
Stotler, H. K., Jr.
Stotz, J. K.
Sullivan, M. J.
Terkelsen, Bernhard
Tripp, W. C.
Whitsett, J. David
Wilbraham, E. L.

SECRETARY CONWAY: Our President is out of the city, our First Vice President is ill and will not be able to be with us tonight, and our Second Vice President is not available. It is customary when we need a pinch hitter to call on the Pitts-

burgh & Lake Erie. With your approval I will ask Mr. John E. Hughes, a former President of the Club, to preside.

MR. HUGHES: This is indeed a surprise. The first order of business tonight, if you are uncomfortable, is to remove your coats and make yourselves comfortable. As I view the subject of the evening, it is going to be very interesting, and probably considerably cooler as the evening goes on.

We will dispense with the roll call as you have all signed registration cards which give a complete record of the attendance.

As the Proceedings have been already printed and distributed, if there is no objection, we will dispense with the reading of the minutes.

Mr. Secretary, are there any proposals for membership?

SECRETARY: I think this breaks our record, when we have no proposals for membership to present. It means that we will have to work a little harder in that direction.

Since our last meeting we have received information of the death of one of our members, Ralph H. Tate, Vice President, Fort Pitt Spring Company, Pittsburgh, died May 5, 1933.

PRESIDENT: As is our custom an appropriate memorial minute will appear in the next issue of the Club Proceedings.

If there is no further business, we come to the address of the evening. I want to say that we are much indebted to the Westinghouse Club Quartette for the splendid entertainment we have received and which we have enjoyed very much. I take this opportunity to extend to them the thanks and appreciation of the Club for their courtesy.

The first speaker, on the subject "General Comments on Air Conditioning," is Mr. S. M. Kintner, Vice President of the Westinghouse Electric & Manufacturing Company, whom I take pleasure in presenting to you at this time.

GENERAL COMMENTS ON AIR CONDITIONING

By S. M. KINTNER, Vice President,
Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Mr. President and Members of the Railway Club of Pittsburgh: In speaking on a subject that ought to be of interest to you here tonight, it occurred to me that it might be best to

confine my remarks more to what we are trying to get than to how we are trying to accomplish it. You will remember there is an old Scotch recipe for making rabbit soup which starts off with the instruction to first catch your rabbit. I think that is a very good formula to follow in considering air conditioning.

The "rabbit" in air conditioning is comfort. What therefore is comfort? That is what we are striving to get. As I see it there are five principal elements that determine our comfort. The first is that of the temperature of the air. The second is that of its humidity. The third is cleanliness. The fourth is the freedom from or the presence of certain vibrations, in the one case disagreeable and in the other case agreeable. I think we have had a very excellent demonstration of the latter type of vibrations from the Glee Club. And the fifth element is that of the quality of the air. I am speaking of it in this broad term of quality and I shall explain a little more in detail later.

In the past we confined ourselves very largely to attempting to control temperature. In general we have undertaken to maintain a higher temperature of the air by building more fires in cold weather, and in the summer time we have either gone to the seashore or the mountains—those who were able to—and those who stayed at home attempted to fan themselves in the effort to control temperature by that means. So that temperature is a very necessary thing in the control of air conditioning.

The next element is humidity. Humidity, and I speak of relative humidity in this sense because by humidity we mean the amount of moisture that the air can carry as a vapor and this varies with the temperature of the air. As the temperature of the air is raised the amount of moisture that is capable of being carried in the air as vapor is increased; as the temperature is lowered the amount of moisture the air can carry as a vapor is decreased. So in speaking of humidity it is necessary to speak of it as relative humidity at a particular temperature. If you have air with 15% or 20% moisture, 15% or 20% relative humidity at a particular temperature, on raising the temperature of that air the relative humidity would be lowered because the air at the higher temperature would be capable of carrying more moisture. On the other hand if you lower the temperature the relative humidity would be increased, and it might be increased clear up to 100%, and if you cause the temperature to go still lower the moisture will no longer remain a vapor but will precipitate on cool surrounding objects, as you are familiar with in the case of the water pitcher where the moisture condenses as

the air contacts with the cooler surface of the pitcher. Humidity is very important, and these two, temperature and humidity, are closely related to each other. There is, as determined by certain experiments, a definite zone within which a person feels comfortable. This zone is bounded by temperature and humidity values. In the winter time you can be comfortable in a 66° room provided the humidity is 90%. As the humidity is lowered, say to 10%, we have to have the temperature raised to 72° or 73° in order to be comfortable. In the summer time we experience a similar condition of comfort in this way. If we have a high humidity say 90%, it is necessary that the temperature be limited to a maximum of 70° or 72°. On the other hand if the humidity is lowered to 10% we will feel very comfortable in a temperature of 81° or 82°. So you see this range of temperature and humidity establishes what we call a zone of comfort. When we keep within that range of humidity and temperature we experience what we call comfort, insofar as humidity and temperature affect comfort.

A human being is more or less of a heat engine. The average individual, following a sedentary occupation, seated at a desk and not exerting physical effort, generates and must get rid of 400 British thermal units of temperature in order to be comfortable. If he does not get rid of that much his temperature will go up, and whenever your temperature goes up or down you are uncomfortable. Your normal temperature is about 98.6° and anything that tends to cause a departure from that creates discomfort.

This 400 B.t.u. of an inactive person, may vary considerably as you exert yourself. Those who are subject to strenuous physical effort may have to eliminate as much as 1300 B.t.u. per hour, more than three times as much. The 400 British thermal units per hour are the equivalent of 117 watts, two 60 watt lamps. That is the heat energy that is being developed and eliminated. So the number of people in a room materially affects the temperature of the room. This effect is shown by some figures I made recently for a particular building at the University of Wisconsin, a very large building that had about 750 couples dancing at one time. The calculation was made on the assumption that with that number of people dancing in that space the exercise of dancing would generate 550 B.t.u. for each person, and there would be three times as much heat energy developed in that building by the dancers as was required to maintain a proper temperature of 66° to 68° in the room,

with an out door temperature of 25°, and about 50% more heat than was required with an out door temperature of zero. That is if you did not have any artificial means of heat, that is other than the heat generated by those dancers, that heat alone would be more than sufficient to heat the room. And that may be the reason for the parade of the dancers between dances to store up a little extra cold to counteract the surplus heat generated.

You may be interested to know how the human being gets rid of that heat energy. They get rid of it in three ways, 46% by direct radiation, 30% by convection, and 24% by evaporation. That is by radiation heat energy goes directly from the surface of the body to the surrounding objects. If those surrounding objects are at a lower temperature than the human body that heat energy flows quite freely. If those surrounding objects should be near the same temperature as the surface of the body there would be practically no radiation elimination and the 46% of the 400 B.t.u. would not be eliminated by radiation. If any one of the three ceases to function the other two will have to take care of that condition by increasing their activity. If you cut off radiation by an increase in the temperature of surrounding objects the evaporation and convection will have to increase.

So in order to be comfortable it is necessary to keep the proper balance between these three things. Not exactly the same percentages I have indicated, because these are only averages. We may be comfortable if we increase the supply of one and let the other two down. That is if you have a fan blowing the air and if you increase both the evaporation and the convection losses that makes it unnecessary to eliminate the same amount of heat energy by radiation.

We have run some rather interesting experiments on radiation in the laboratory. In the winter time we ran cold air into a special room without heating the air in any way, but we had the panels in the room built up with electric heating units in them and electric energy was passed through these and heat developed. The temperature of the surface of the room was 80° to 82°, and as the temperature of the normal individual on the surface will average 80° to 82°, this condition thereby eliminates radiation losses. In order to be comfortable it was necessary to increase the other losses. And we found that if we immersed the individual in a cooler air we could get that condition. I found myself very comfortable in that room with a temperature of 55°, more so than in a room at 72° under ordinary methods of home heating. There is a different sort of stimula-

tion that you do not get from the warm air. The cooler air is much more vitalizing.

I have a suspicion, indeed I think I may say that it can be demonstrated, that we can reverse this process and in the summer time we can chill the walls of the room or the surrounding objects and in that way increase the radiation and make it comfortable for human beings in a warmer atmosphere. I do not believe we will have the same vitalizing action but I am certain we will feel more comfortable than without such means.

However as you begin to cool surface in that way you may expect to accumulate a certain amount of moisture by condensation. So these three factors of radiation, convection and evaporation are very vital elements that must be kept well in mind in seeking comfort in air conditioning.

There is another very vital element, that is the question of cleanliness in the air. We in Pittsburgh know that there is a great amount of dirt carried in the air. It is no uncommon thing to find a deposit of 200 tons of dirt from the air per square mile per year. This is not only in Pittsburgh but in a number of other cities because Pittsburgh is not the worst of cities in that respect. When it comes to the source of the dirt it is not the large factories that are the worst offenders, it is rather the small householders. Also the traffic of the streets puts a large amount of dirt in the air. The automobile tire is an ideal dirt distributor as you can judge by the amount of dust it throws up in running over a macadam road. So for a proper air conditioning it is necessary to free the air of all the dirt and this is a very difficult thing to accomplish with entire satisfaction. There are a number of ways of doing it. One is to wash the air, pass it through a spray of falling water. Another is to pass it through baffles, filters or strainers, and trap the dust particles. Still a third way is by means of electric precipitation which causes the little particles to become charged and deflected by collection plates which effect their elimination from the gas. That is proving the most effective way of removing the dirt of the air.

The fourth item I mentioned is that of vibration of the air. When we speak of vibration in the air there are two kinds, one of a desirable and the other of a disagreeable character. The desirable kind quite frequently is absolutely quiet. This is a time when people are seeking more quiet conditions. We are having more trouble with machinery today from noise—and it is better than it ever has been before—than most any other kind

of trouble, and there is complaining on the part of everybody. There is scarcely a street car passing but that you notice it. Exhaust fans in your offices are running all day and you are surprised at your sense of relief when the exhaust fan shuts down at the close of the day. You have been under a strain by it all day without being conscious of it. So it is necessary that noise be given due consideration.

There is another kind of noise that is desirable, that is proper music. That at times is very desirable. We should be able to have means provided to set up the desirable kind of vibration and give us that kind of stimulation that gives us pleasurable sensations.

There is a fifth element which I have spoken of as the quality of the air. Under that general heading I want to mention two or three things. First there are the odors that are present in all airs that come from human beings or from products left around the house that are disagreeable. It is necessary to eliminate those odors. There is a certain amount of disagreeable gas that is produced by our normal functions of breathing. We exhale about so much CO_2 every time we breathe. CO_2 is a gas that does not promote a good condition of air. Normally there is no danger of being poisoned by an excess of CO_2 without being conscious of it because the air always gets to a condition of stuffyness and disagreeableness that makes you aware of those conditions and you move out before the danger point is reached. There are instances where people work in submarines in a 10% concentration where ordinarily 5% of CO_2 makes what is considered a concentrated condition. There is not as yet enough thoroughly established facts to set the proper limits on this condition.

There is another feature of these products in the air. Go to the sea shore or to the mountains and you know you find a different kind of air from what you have here. It has a vitalizing effect that is missing in the other kind of air. Certain researches indicate that there is a condition which is due to the presence of certain ions in the air. Air with a predominating proportion of positively charged ions produces a depressing sensation, whereas the reverse is true if there is a predominating proportion of negatively charged ions. Certain tests were made where subjects were subjected to an atmosphere with an excessive charge of positive ions and they produced such a low order of mental feeling that they could hardly sign their names. We are trying to find ways and means of controlling that and

getting this vitalizing action. As yet that is quite a difficult problem. To my mind there is no question of our finding a way of doing it. We find ways to doing all these things. But we must bear in mind as we are doing it what we are trying to get.

Tonight we are to have the pleasure of listening to one of the engineers of the Westinghouse Company whose special duties have been along the line of air conditioning of railway cars and he will devote his attention and his discussion to that particular phase of the subject.

PRESIDENT: We will defer the general discussion of the subject until after we have heard the second speaker. We are honored in having for the second speaker Mr. Charles Kerr, Jr., Railway Engineer, Westinghouse Electric & Manufacturing Company on the subject of Air Conditioning for Railway Passenger Cars. I take great pleasure in presenting to you Mr. Kerr.

AIR CONDITIONING OF RAILWAY PASSENGER CARS

By CHARLES KERR, JR.,
Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

To air-condition a space containing 6,000 square feet offers no difficult problems. However, if that space happens to be a railway car, then it offers many most interesting engineering problems. As you all know, railway service offers the most exacting requirements, principally in the form of space and weight limitations, and also because of the severity of the service. For these reasons, apparatus suitable for ordinary industrial use is not applicable to the conditions encountered in railway operation. The conditions set by railroad requirements have been met, and today reliable apparatus is available for use on railway passenger cars, which has several millions of miles of service as a background.

The popular opinion that air-conditioning represents a three or four-months' investment is erroneous. It is a twelve-months-a-year investment. As now applied to railway cars, air-conditioning constitutes the maintenance of the proper conditions for passenger comfort within a car the entire year under automatic control. It is almost as essential for comfort to insure the correct conditions in cold weather as in hot.

Modern apparatus cools and dehumidifies during the summer. The control of humidity, as well as of temperature, is essential to comfort. The degree of cooling is a function of outside temperatures. The interior should never be cooled below 72 degrees, nor more than 15-18 degrees below outside air at any time. Any predetermined inside condition will be maintained by the apparatus automatically, unless that condition exceed the capacity of the equipment. In cooling the air, moisture is removed, thereby giving humidity control.

During the winter, the equipment not only heats, but adds moisture to the air. You are familiar with the dry, overheated cars of today. Instead, a temperature of 72-74 degrees is automatically maintained with the proper humidity.

At all times, whether heating or cooling, the proper proportion of outside air is brought into the car to assure healthful conditions. All windows are kept continuously closed, the air entering at one place only where it is filtered. Therefore, a clean ride is assured in all climates. Hence, an air-conditioned car offers the most comfortable ride that it is possible to provide.

Apparatus Required:

The apparatus involved in the air-conditioning of a car has been greatly simplified since the earlier installations, and the weight practically halved. The apparatus may be divided into three units:

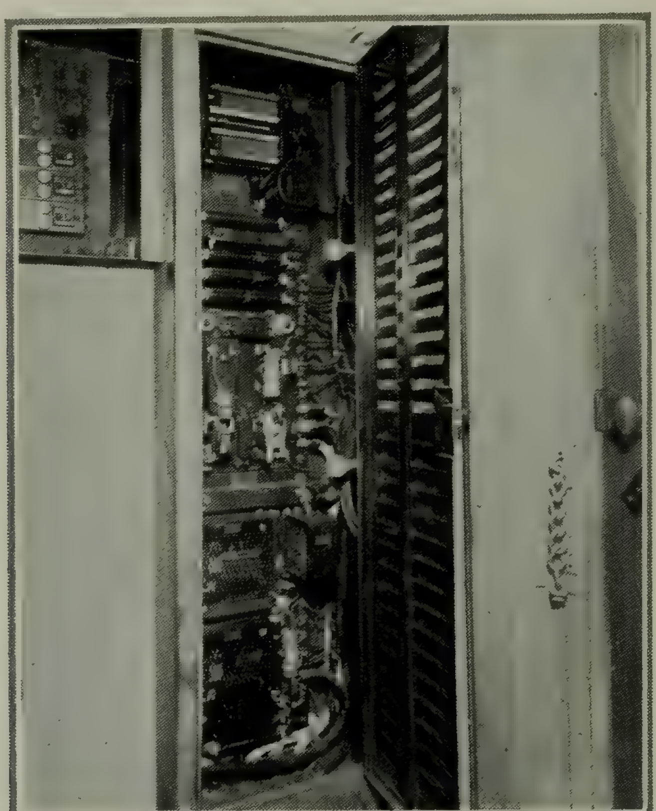
1. The source of power, usually an axle generator located on the car truck, augmented by a storage battery.
2. The refrigerating unit located under the car floor.
3. The air-conditioning unit located near the car roof.

The refrigerating effect may be supplied in three ways, but all systems require a source of power and a roof unit where the air is actually cooled. The refrigerating unit may be an ice box which cools the circulated water, a steam jet refrigerating unit, or a mechanically-driven compressor unit. Each system has its proponents, and each system is in successful operation. This paper, however, will be confined to the compressor system, which constitutes by far the majority of equipments now in service.

Requirements:

Air-conditioning has been applied to all types of passenger cars, including coaches, parlor cars, dining cars, sleeping cars, lounge cars and observation cars. The requirements of the

several types differ to a certain degree. However, it is not feasible, from a manufacturing standpoint, to manufacture a wide variety of types. Careful calculations, backed by operating experience, indicate that a cooling capacity of 6 tons of refrigeration (72,000 Btu. per hour) will be ample for any normal car in any section of the country. To provide this capacity in a cooling system requires approximately 9 kw. in power for continuous operation. However, the apparatus seldom operates over 60 per cent of the time on the average. In addition, the power plant must provide for the car lighting and battery charging. The sum of these loads necessitates an axle generator of 15 kw. capacity, compared with existing machines of 4 kw. The battery capacity is likewise increased from 300-600 ampere-hours capacity to 800-1000 ampere hours capacity. To meet these larger requirements, the battery manufacturers have developed a new light-weight battery.



The automatic features of the equipment make supervision simple. The Controls fit standard lighting control cabinets.

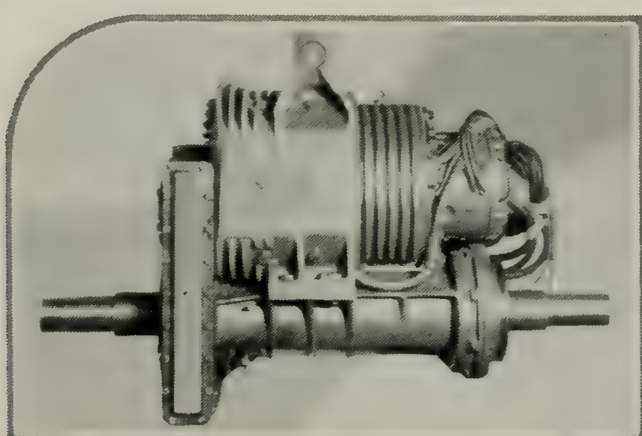
Power Supply:

The power supply for a railway car has always been a problem. The maintenance of car lighting apparatus has been an item of magnitude. The number and types of generator drives

tried and found wanting are legion. The most universally used drive is the flat belt, but from past experience its capacity seems to be definitely limited to a capacity not exceeding 5 kw. Then, to provide a drive for a 15 kw. generator required the development of a radically new drive.

The entire air-conditioning development hinged on the development of a source of power. No apparatus could be more reliable than its source of power. For a positive, long-life drive, free from troubles, no form can equal the gear type. Many objections were raised by operators to this type of drive, but most of the troubles forecast have never occurred. Previously gear drives had been tried, but without success. The reasons for these failures lay principally in the attempt to operate industrial gear designs on a railroad.

Gear drives have been used on electric locomotives and cars in heavy railroad service for years with driving motors with capacities as high as 1250 hp. Then there was no reason why a successful drive for a 15-kw. generator could not be



The 15-kw. Axle Generator supplies power for air conditioning, lighting, and battery charging. Its gear drive has an operating background of 12 million miles.

made. There were truly billions of miles of operation as a background. From this background a succesful gear drive for axle generators has been developed, and before a group of railway operators, a somewhat detailed description of it is probably in place.

An oil-tight gear unit was developed consisting of a gear pressed onto the car axle, driving the generator pinion. All bearings are of the roller type, providing long life. The unit is filled with oil and requires re-oiling only a few times a year. The generator and drive will fit into any standard gauge four-

or six-wheel truck. The generator bolts to the gear unit on the axle side, and is supported from the truck end sill on the other side. The arrangement is very similar to that used on locomotives and cars. Twelve of these generators have operated a total of 1½ to 2 million revenue miles with only three failures, the causes of which have been corrected. One was primarily a control failure, and the other two bearing failures from faulty lubrication. For a new development this is a remarkable record, especially compared with belt-drives which, after twenty years or more of development, last only 25,000-75,000 miles. The gear life, based on past gear experience, should easily exceed 1,000,000 miles.

When this drive was developed, three principal objections were brought forth to prove that it would never work. All of these have been proven to be unfounded. First, it was claimed that the shocks imposed on the gear teeth when coupling cars would be so great that their use would be prohibitive. Three types of gears were placed in service: solid, flexible and slip. After almost two million miles, none have failed or shown signs of failing. Secondly, it was claimed that any generator failure which caused it to lock would cause the wheels to lock also. The slip gear has taken care of this. One of the failures referred to above actually locked the generator on one drive with a slip gear. The car operated for four hundred miles without delaying the train one minute, or putting a flat spot on the wheels. Third, the gear drive would be entirely impossible to operate because of flat wheels. A flat wheel has yet to be changed on a generator drive wheel. The momentum of the drive keeps the wheels from getting flats. On one train every car had flat wheels after an emergency application, but every generator wheel came through without flats. This same experience has been repeated time and again.

The generator developed for this service delivers 15 kw. continuously. To operate with present lighting circuits, it is designed for 32-volt operation using either lead or Edison batteries. It can be wound for 64 volts whenever required. The control for this type of machine has been greatly simplified, eliminating all mechanical brush-shifting devices and carbon pile regulators. The battery-charging characteristics are ideal.

The power supply for passenger cars has received an untold amount of attention for many years. The development of this drive has been a real contribution to this subject, and its successful operation appears to be a solution of the troubles.

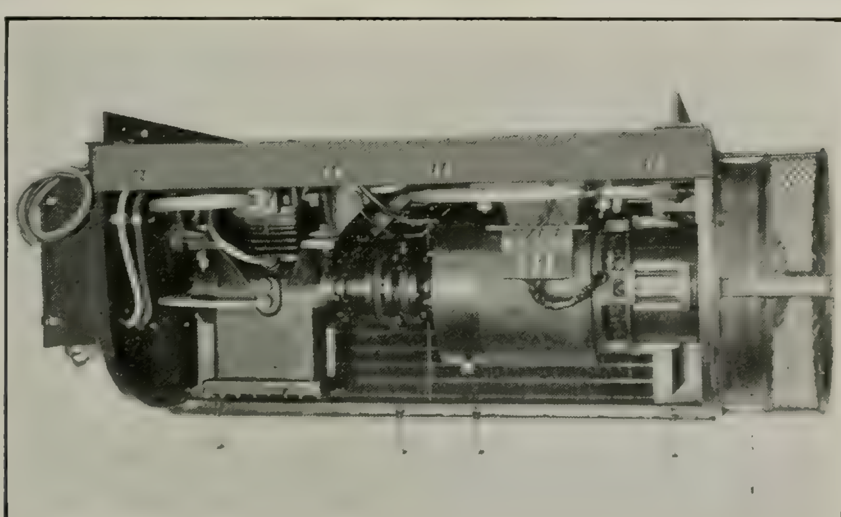
There are many advocates of a head-end power supply for the entire train. This system has merit. The manufacturers are prepared to furnish this system whenever there appears a demand for it. Its successful use requires the equipment of all cars with train lines, and this has so far prevented its adoption.

There has been, in certain quarters, an objection to any geared drive because it requires a special axle. Last fall a special belt drive, using four "V" belts and a truck-mounted, 15-kw. generator, was installed for trial. This drive has operated almost 75,000 miles with no failures, and the original belts have a great deal of mileage left in them.

Refrigerating Unit:

Due to the limitations in power supply, the refrigerating system must be efficient. Furthermore, it must employ a refrigerating medium which is harmless, and operate without the use of water to provide an installation with reasonable maintenance. It must also be small in size, light in weight, and require no floor space to mount.

The attainment of this type of unit was dependent upon the developmnent of a high-speed, light-weight compressor using Freon as a refrigerant, and with a volumetric efficiency comparable to that of the slow-speed compressors. A compressor meeting these requirements has been developed.



Refrigerating Unit—Cover Removed.

The refrigerating apparatus is mounted in a single unit, suitable for mounting to the underframing of a car. This unit contains the compressor, driving motor, condenser, fan, liquid tank and oil separator. To eliminate belts, gears, etc., the com-

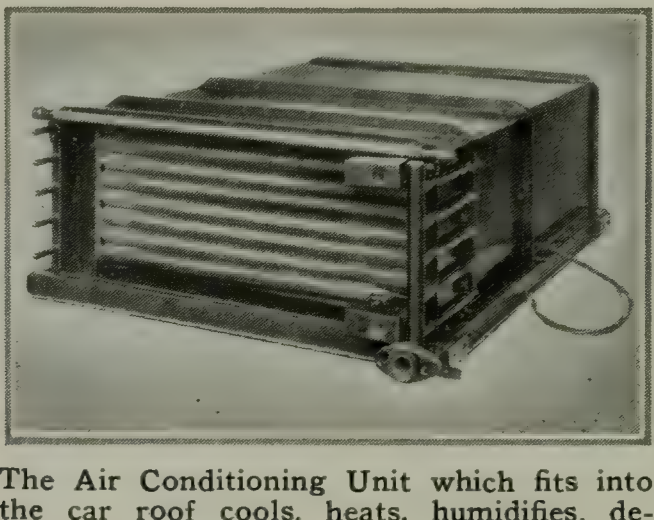
pressor is direct-driven by the motor. The fan is mounted direct on the motor shaft.

The refrigerating medium, in the form of a gas, is compressed to 150-180 lbs. pressure in the compressor. It then passes to the condenser, where heat is extracted by air which is furnished by the fan. The liquid then passes to the coils which actually cool the car air. In these coils the liquid expands into a gas, lowering its temperature, and when so doing cools the car air. This gas then returns to the compressor.

Air-conditioning must be provided whether the car is moving or standing. Also, parked sleepers, etc., may be cooled for several hours, which is beyond the capacity of the battery. To provide for this pre-cooling, an AC-DC driving motor has been provided. When the train is moving, or during intermediate stops, the compressor operates from 32 volts D.C. When pre-cooling, commercial 220 or 440-volt central station power can be used. During this pre-cooling period, the D.C. motor acts as a generator to charge the battery if required.

Air-Conditioning Unit:

The air-conditioning unit may be furnished in one or more sections, depending upon the best arrangement for the car in question. These units consist of the heating and cooling coils, over which the circulated air is passed by the fans. The total amount of air circulated ranges from 2000-2500 cu. ft, per minute.



The Air Conditioning Unit which fits into the car roof cools, heats, humidifies, dehumidifies and ventilates.

Outside air, about 25 percent of the total, is drawn in back of the unit through filters in the deck. The remaining 75 percent is recirculated in the car. The use of forced draft creates

a slight pressure in the car, causing all air passing through window cracks, etc., to be out, not in. Hence all dirt is kept out. By constantly bringing in such large volumes of new air, a complete air change is obtained every few minutes.

As the air passes over the cooling coils, it is cooled to about 60 degrees. In the process of cooling water is removed. The air then passes into the upper air of the car where it is mixed with the warmer car air. This cold air blanket slowly descends over the entire car, and then is returned again to the air-conditioning unit by forced draft. The air distribution system must be so designed that the air is uniformly distributed without drafts.

Heating:

During winter weather the same air circulation is maintained, except the heating coils are used rather than the cooling coils. After the air passes over the heating coils it is subjected to a fine spray of water or steam to increase the relative humidity.

As warm air will not descend to the floor, the present steam pipes must be retained for floor heat. All heating has been placed under thermostatic control, enabling the proper temperatures to be maintained. The addition of moisture to the heated air furnished by the roof unit assures the proper humidity in the car.

The proper heating is most important. As an illustration, last winter an air-conditioned coach was operated in a through north and south run. On one trip seven Pullman passengers sat the entire day in the coach due to the improved conditions in it.

Distribution of Air:

One question that is receiving considerable attention is the method of distributing air in the car. This may be done by discharging the air directly into the car from the cooling units, or through ducts. For short cars, like diners, direct discharge gives acceptable results. For long cars, duct distribution is far superior.

The ducts may be constructed in several ways. The system most generally used has been the construction of an outside duct along the deck, discharging horizontally into the upper part of the car. Inside ducts along the side have been used, and lately center ducts have been advocated. Any of these

methods provide successful operation, and the determining factor is usually the car design itself.

Weight:

The complete weight of the air-conditioning equipment is approximately 5400 lbs. To this must be added a larger battery, and from it must be deducted the weight of the present car lighting equipment which is removed. The net increase will range from 5500 to 6500 lbs. depending upon the exact details of the installation. This represents an increase in total car weight of about 3 to 3.5 percent.

Operation:

There are today several million miles of operation behind mechanical systems of air-conditioning. It is frankly admitted that in the early stages the manufacturers had their troubles. However, these troubles were invariably with details and have not required major changes. In the development of a new art, these difficulties are to be expected, and today a perfectly practical equipment is available for universal application to railway cars.

Installation and Operating Expense:

The cost of installing air-conditioning apparatus is not great. Many erroneous costs have been circulated, for in some cases cars have been rebuilt and these costs charged against air-conditioning. When equipping cars in quantities, from 20 and up, the total installation ready to operate can be made for $5100 to $6000 a car. From this cost should be deducted credits for car lighting equipment and other salvaged apparatus.

The cost of operation depends to a large extent upon the system of bookkeeping used. The actual out-of-pocket expense will average about $1100 a year including power, maintenance, fixed charges and depreciation for a car making 125,000 miles per annum. By attracting an additional one-third passenger per car mile, the entire cost is repaid, and any additional traffic is profit. Improved service of this type is essential if the railroads are to regain their lost traffic.

PRESIDENT: The subject of the evening is a very modern innovation toward comfort in traveling, particularly I would say in railway cars. Vice-president Kintner and his Chief Engineer, Mr. Kerr, have given us a very wonderful description of this new arrangement and I think we should have a very free discussion of the subject from the members on the floor.

I have a list of names here that fortunately we get through the registration cards, which gives the President an opportunity to call on some of you. We would like to hear from Mr. Cutler, of the General Electric Company.

MR. D. E. CUTLER: I have enjoyed the paper very much. I do not think I have anything to say further.

PRESIDENT: We have Mr. Canon, Superintendent of Air Conditioning, Duquesne Light Company, from whom we would like to hear.

MR. H. A. CANON, Supervisor of Air Cond.- Sales Promotion: I do not have anything in particular to offer. I would like to ask Mr. Kerr one question. Is the air conditioning compressor equipment manufactured by the Westinghouse Company driven at all times from the battery located on the car?

MR. KERR: The axle generator supplies power for the air conditioning above 22 miles per hour. Outside of the terminal pre-cooling, below that speed the power is supplied by the battery. At speeds above 22 MPH the generator supplies the power and also keeps the battery charged. At terminals, for long periods, we have the A.C. switched on to the commercial power.

MR. CANON: The car of the Pennsylvania Railroad that was exhibited the other day called the "Nocturne" as I understood it the power at all times was taken from the battery. The battery was on a trickle charge while the car was moving over 22MPH. and charged by anM.G. set while in the station.

MR. KERR: I did not see that car. What they probably had, was operation from the battery charging lines. Was the car on exhibition?

MR. CANON: Yes.

MR. KERR: That is probably the way it was arranged.

MR. J. W. LOGAN (Union Switch & Signal Co.): I would like to ask Mr. Kerr whether there is any particular reason why the circulation of the air was from the top to the bottom?

MR. KERR: In the winter time the only place you can put it in is at the roof, if you use a combination of roof heat and floor heat.

MR. LOGAN: I had in mind circulation in winter time. In the Pennsylvania Railroad P-70 Coaches warmed air is brought in from the floor, I think.

MR. KERR: That would mean another set of blowers on the floor.

MR. H. D. McKINNON: I would like to ask Mr. Kerr if he can make a comparison of the weights of the three systems he mentioned.

MR. KERR: The ice system of course will vary depending on the capacity of the ice you put in the unit. I think that system will run somewhere about 8,000 to 11,000 lbs., including the weight of the ice. The steam system I could not tell you exactly but I understand it weighs about 8,000 lbs. but that is more or less guessing and I can not vouch for it. The compressor system weighs about 5400 lbs.

MR. T. P. IRVING, (C. & O. Ry. Co.): The weights of some of the air conditioning systems now in use are as follows:

York Compressor System, Weight 8,000 lbs. complete including ducts

Carrier or Steam System, Weight 10,700 lbs. completely installed.

Pullman Compressor System, Weight 8,000 lbs. completely installed.

Ice System having a capacity of 1,800 lbs. of ice, total weight 5,800 lbs. including the ice.

MR. KERR: When I was referring to the ice system I was referring to the weight of the apparatus plus about 4,500 lbs. of ice. The weight of the ice was included.

MR. IRVING: In 1932 twenty-four Pullman assigned cars, three C&O Diners and three C&O Coaches were equipped with the Pullman Air Conditioning System for service on THE GEORGE WASHINGTON; two of the Pullman Cars had the Westinghouse Electric & Manufacturing Co.'s drive, the remaining cars had the Pullman Dynamatic Clutch Drive.

In 1933 twenty-six Pullman assigned cars and six C&O Passenger train cars were equipped with the same type of air conditioning system as those applied in 1932.

MR. F. C. AMENT: I would like to ask Mr. Kerr if it requires any more heating system to heat the car in the winter time than it does ordinarily now.

MR. KERR: I do not know that I can answer that question exactly. As far as I know it will probably take less. That is we control the heating of the car, and also, through the higher humidity it is necessary to carry a lower temperature in the car to be comfortable. If you raise the humidity in the car you may lower the actual temperature. I know certain people claim big reductions in steam. I can not vouch for it. I think last winter was a light winter and they got lower steam consuption than they would get in a bad winter. Actually we have not any definite figures but I think you will get if anything a less consumption of steam rather than an increase. Also another thing should add to it. As long as it is automatic control you maintain a proper temperature instead of 10° too high as a lot of the porters will do. I think you can count on some appreciable reduction in the amount of steam consumed in heating. Quantitatively I can not tell you exactly.

MR. W. FRANK WEAVER (The Pullman Co.): I think I can answer that question about the operation of the air reconditioning unit on the Pullman car Nocturne. That unit is a Frigidaire machine, and is equipped with a supplementary generator of about 300 ampere capacity. also an enlarged battery of 1,000 amp. hour capacity. The cooling unit in this case draws its power directly from the battery at all times.

MR. McKINNON: May I ask one more question? Speaking of the circulation of air in compartment cars, the question comes up of serving air to the sleepers where you have upper and lower berths. Is it possible to arrange the circulation of air so as to distribute it to all berths during the night?

MR. KERR: I understand the Pullman people are using a duct system of distribution very successfully, a center duct down the middle of the car, and I was told they have developed a curtain for the cars that allows air to permeate through the curtain and they can maintain both upper and lower berths with very little difference in temperature. They had a center duct about six inches below the roof of the car.

PRESIDENT: Mr. Samuel Lynn, Superintendent of Rolling Stock, Pittsburgh & Lake Erie, may we hear from you?

MR. SAMUEL LYNN: I came here tonight to get some information as this is a very live subject with the Railroads at the present time, and after hearing the discussions and viewing

the illustrations, I feel that my time here tonight has been well spent. I do not know that I can say very much that would be enlightening to our members for the reason that I have not had much experience with any of the equipment as discussed. As some of you no doubt know, we have in use the outside cooling system which is used principally to cool sleeping cars and parlor cars and when the opportunity affords we also precool some coaches. On the sleeping cars, we obtain very good results. This is due to the fact that the cars are in through runs and doors and windows are not opened as frequently as would occur on cars used in surburban service.

However, I would like to ask the speaker one or two questions. The introduction of precooling machinery on Railway equipment was done primarily to get cool cars in the summer months and I now understand from what one of the speakers stated that this equipment would cost on an average of from $5,000.00 to $6,000.00 a car to properly equip the car and keep it comfortable in service. It is my further understanding that with the equipment as discussed here tonight, it will be used not only during the summer months but the year around, as when it is not needed for cooling purposes, it can be used to regulate the heating of the cars during the winter season. I would like to ask as to what saving can be effected in heating during the winter months to offset the expenditure which I understand would be necessary. In other words, can the Mechanical representatives of the Railroads show the Management where the installation of this equipment will eventually save us some money? I appreciate that with a precooling system such as we are using, it is quite impossible in large terminals to take care of all the equipment.

Another question I would like to ask is: On coach equipment where all the cars are equipped with a system of this kind, what results would be obtained on extremely hot days, particularly in suburban service where the doors are opened at frequent intervals to permit the discharge and reception of passengers, which permits the passage of outside air through the cars? It has been our experience with the precooling device, particularly in coach service, after the cars get out the line 25 or 30 miles, there is very little difference between the temperature in the car and the outside temperature and I would like to know if passenger coaches equipped and operating under a condition of this kind would carry a uniform temperature.

MR. KERR: Answering your first question about the cost,

I think where you have got to get your pay for the air conditioning apparatus is in the increased business you will obtain from its installation in the passenger service. In the other case, as far as the saving of heating is concerned, we know that locomotives are now so efficient they do not use any coal any way, so we have not much chance to save that way.

In regard to keeping the coaches cool, you have a condition where you pre-cool and when you leave the terminal the cooling is stopped. They will then heat up rapidly. But in this case we have had this equipment operating on coaches in fairly local service, making about twenty mile runs and we keep those cars cool with the doors opening—shutting at an average stop of two or three minutes. But in main line service with stops lower than twenty miles between stops, we have had no experience in that.

PRESIDENT: Mr. Karl Berg, Superintendent of Motive Power, Pittsburgh & Lake Erie, can you add anything to the discussion?

MR. KARL BERG: I think, Mr. President, you can appreciate how difficult it is for me to ask questions about an apparatus I know little about, as I have not had an opportunity to study it very much so far. It seems, however, very evident that there will be a demand for an apparatus of this kind that will modify passenger car temperatures both winter and summer. I can see from my own viewpoint that it is coming. I am a little bit like Mr. Lynn, I do not know just how we are going to pay for it, but nevertheless, there will have to found a way out, as there will undoubtedly be a demand for that sort of thing.

I cannot ask any questions about the air conditioning system itself, as it looks to be a very compact and well-designed machine, and no doubt will do the job. The thing that occurs to me in looking at the picture is that if too great a portion of the 6,000 lbs. additional weight of this machine would have to be located at the top, or the clear story of a car, it may affect too much the location of the center of gravity of the car. This is the question I would like to ask, particularly if we are to apply same to the lighter passenger equipment that in all probability will be used in the future.

MR. KERR: In regard to the distribution of the weight, the generator, refrigerating unit and the battery, which is about

80% of the entire weight of the apparatus, is below the level of the floor of the car. Does that answer your question? Of course the generator weight is not on the car at all, it is on the truck.

PRESIDENT: I am glad we have had such a free discussion of this subject. Mr. Kintner, have you anything further you would like to say? If not, may we ask Mr. Endsley for any comments he may wish to make.

PROF. LOUIS E. ENDSLEY: I am very glad indeed that I was here tonight and I think I can testify for the rest of us in the room that we have enjoyed very much the clear analysis of what we mean when we say conditioning air, as well as what can be done to make a car comfortable in the winter time as well as in the hot summer day. I am sure this Club wants to express its appreciation of the two gentlemen for the preparation and presentation of this paper and for the very excellent discussion, and I would therefore move a rising vote of thanks to those two gentlemen, and I would wish to include in it also the gentlemen who gave us such a delightful entertainment prior to the meeting.

The motion prevailed by unanimous rising vote.

J. D. CONWAY, Secretary.

In Memoriam

RALPH H. TATE

Joined Club December 27, 1928

Died May 5, 1933

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ANALYSIS OF EQUIPMENT MAINTENANCE

By LAWRENCE RICHARDSON,
Mechanical Assistant to Vice President and General Manager,
Boston and Maine Railroad, Boston, Mass.

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E. W. SMITH, Vice-President, Penna. R. R., Philadelphia, Pa.
LOUIS E. ENDSLEY, Consulting Engineer, 516 East End Avenue, Pittsburgh, Pa.
JOHN E. HUGHES, General Agent, P. & L. E. R. R., Youngstown, Ohio.

Membership Committee

A. F. COULTER, Master Car Builder, Union Railroad, East Pittsburgh, Pa.
F. L. DOBSON, Supt., Phila. Terminal Division, Pennsylvania Railroad, West Phila., Pa.
J. L. O'TOOLE, Assistant to General Manager, P. & L. E. R. R., Pittsburgh, Pa.
T. FITZGERALD, Vice-President, Pittsburgh Railways Co., Pittsburgh, Pa.
F. J. NANNAH, Engineer Maintenance of Way, P. & L. E. R. R., Pittsburgh, Pa.
A. M. FRAUENHEIM, Vice-President, Standard Auto-Tite Joints Co., Pittsburgh, Pa.
H. T. CROMWELL, Asst. Shop Supt., B. & O. R. R., Glenwood, Pittsburgh, Pa.
E. EMERY, Railway Supplies, 6511 Darlington Road, Pittsburgh, Pa.
E. A. RAUSCHART, Mechanical Supt., Montour Railroad, Coraopolis, Pa.
HERBERT J. WATT, Mgr. of Sales, Rwy. Material, Jones & Laughlin Steel Corp., Pgh., Pa.

Subject Committee

R. P. FORSBERG, Chief Engineer, P. & L. E. R. R., Terminal Bldg., Pittsburgh, Pa.
H. W. JONES, Gen. Supt. Motive Power, Pennsylvania Railroad, Pittsburgh, Pa.
D. W. McGEORGE, Secretary, Edgewater Steel Co., P. O. Box 249, Pittsburgh, Pa.

Finance Committee

CHARLES ORCHARD, 5849 Hobart Street, Pittsburgh, Pa.
JOHN B. WRIGHT, Asst. Vice-President, Westinghouse Air Brake Co., Wilmerding, Pa
HARRY W. LEHR, Gen. Fore., Pass. Car Insp., Penna. Railroad, Pittsburgh, Pa.
J. S. LANAHAN, Vice-President, Fort Pitt Malleable Iron Co., Pittsburgh, Pa.
F. X. CHRISTY, Inspector, Pennsylvania Railroad, Pittsburgh, Pa.

Entertainment Committee

JOSEPH H. KUMMER, Gen. Sales Rep., Fort Pitt Malleable Iron Co., Pittsburgh, Pa.
A. B. SEVERN, Sales Engineer, A. Stucki Co., Pittsburgh, Pa.
J. W. HOOVER, Chief Traffic Dispatcher, Carnegie Steel Co., Pittsburgh, Pa.

Reception Committee

F. H. FRESHWATER, Sales Agent, Pressed Steel Car Co., McKees Rocks, Pa.
W. P. BUFFINGTON, Traffic Manager, Pittsburgh Coal Co., Pittsburgh, Pa.
T. F. SHERIDAN, Asst. to SMP & SRS., P. & L. E. R. R., McKees Rocks, Pa.
HAROLD F. DUNBAR, Sales Rep., McConway & Torley Corporation, Pittsburgh, Pa.
T. E. CANNON, Gen. Supt. Motive Power & Equipment, P. & W. Va. Ry., Pgh., Pa.
KARL BERG, Supt. Motive Power, P. & L. E. R. R., McKees Rocks, Pa.
DONALD O. MOORE, Mgr. Traffic Div., Pittsburgh Chamber of Commerce, Pgh., Pa.
G. M. SIXSMITH, Superintendent, Pennsylvania Railroad, Pittsburgh, Pa.

Past Presidents

*J. H. McCONNELL	October 1901, to October, 1903
*L. H. TURNER	November, 1903, to October, 1905
F. H. STARK	November, 1905, to October, 1907
*H. W. WATTS	November, 1907, to April, 1908
*D. J. REDDING	November, 1908, to October, 1910
*F. R. McFEATTERS	November, 1910, to October, 1912
†A. G. MITCHELL	November, 1912, to October, 1914
*F. M. McNULTY	November, 1914, to October, 1916
J. G. CODE	November, 1916, to October, 1917
*D. M. HOWE	November, 1917, to October, 1918
*J. A. SPIELMANN	November, 1918, to October, 1919
H. H. MAXFIELD	November, 1919, to October, 1920
FRANK J. LANAHAN	November, 1920, to October, 1921
SAMUEL LYNN	November, 1921, to October, 1922
D. F. CRAWFORD	November, 1922, to October, 1923
GEO. D. OGDEN	November, 1923, to October, 1924
A. STUCKI	November, 1924, to October, 1925
F. G. MINNICK	November, 1925, to October, 1926
G. W. WILDIN	November, 1926, to October, 1927
E. J. DEVANS	November, 1927, to October, 1928
W. S. McABEE	November, 1928, to October, 1929
E. W. SMITH	November, 1929, to October, 1930
LOUIS E. ENDSLEY	November, 1930, to October, 1931
JOHN E. HUGHES	November, 1931, to October, 1932

†Resigned.
*—Deceased.

PROCEEDINGS OF MEETING

SEPTEMBER 28th, 1933

The meeting was called to order at the Fort Pitt Hotel at eight o'clock, P. M., with President F. I. Snyder in the chair.

The following gentlemen registered:

Registered attendance, 155, as follows:

MEMBERS

Altsman, W. H.
Ament, F. Chalmer
Ashley, F. B.
Beam, E. J.
Beaver, Roy C.
Beeson, H. L.
Berg, Karl
Berghane, A. L.
Britt, Thomas E.
Burgham, M. L.
Campbell, J. T.
Cannon, T. E.
Carr, T. W.
Carruthers, G. R.
Christy, F. X.
Church, S. L.
Cipro, Thomas
Code, J. G.
Conway, J. D.
Coombe, A. B.
Cotter, G. L.
Courtney, Harry
Dambach, C. O.
Davies, James
Davis, Charles S.
Dickinson, T. R.
Downes, D. F.
Emery, E.
Emsheimer, Louis
Endsley, Prof. Louis E.
Fenton, H. H.
Ferguson, J. H.
Finegan, L.
Fitz Simmons, E. S.
Flinn, R. H.
Forsberg, R. P.
Fox, George W.
Frauenheim, A. M.
Frauenheim, P. H.
Fry, L. H.
Gardner, George R.
Gilg, Henry F.
Glaser, J. P.
Glenn, J. H.
Gray, Guy M.
Hale, Charles E.
Hancock, Milton L.
Hansen, W. C.
Hill, Harold H.
Hilstrom, A. V.
Holmes, E. H.
Honsberger, G. W.
Huston, F. T.
Irwin, R. D.
Kapp, A. C.
Kaup, H. E.
Keller, R. E.
Kelly, L. J.
Kirk, W. B.
Knox, William J.
Kramer, W. E.
Kraus, Raymond E.
Kruse, J. F. W.
Kummer, J. H.
Lanahan, Frank J.
Lee, L. A.
Long, R. M.
Longdon, C. V.
Lundeen, Carl J.
Lynn, Samuel
Mayer, L. I.
Millar, C. W.
Miller, John
Misner, George W.
Morgan, Homer C.
Moyer, Oscar G. A.
Murray, S.
McKinley, A. J.

McKinley, John T.
McKinstry, C. H.
McPherson, A. R.
Nagel, James
Orchard, Charles
Passmore, H. E.
Posteraro, S. F.
Rauschart, E. A.
Redding, P. E.
Renshaw, W. B.
Richardson, E. F.
Rose, A. J.
Robinson, R. L.
Rudd, W. B.
Rutter, Harley E.
Schaffer, W. E.
Seibert, W. L.
Sekera, C. J.
Sheridan, T. F.
Snyder, F. I.
Stein, J. A.
Stoffregen, L. E.
Stucki, A.
Swope, B. M.
Tomasic, N. M., Jr.
Trax, L. R.
Triem, W. R.
Tuttle, C. L.
Urtel, E. J.
Warfel, J. A.
Weaver, W. Frank
Webster, H. D.
Weiler, Paul
West, Troy
Wheeler, C. M.
Wikander, O. R.
Wildin, G. W.
Winslow, S. H.
Winter, Paul S.
Woodward, Robert
Wright, O. L.
Wright, John B.
Wyke, J. W.
Yarnall, Jesse

VISITORS

Boyer, Charles E.
Burriss, W. C.
Candee, A. H.
Chalmers, J. W.
Dickson, K. B.
Ford, J. R.
Gardiner, J. A.
Gollmer, H. C.
Goodwin, A. E.
Heimann, R.
Heyman, John
Hursh, Samuel R.
Kentlein, John
Lewis, S. B.
Lillie, G. W.
Lind, T. J.
Macdonald, G. A.
Miller, F. K.
Miller, Theodore P.
Nagel, J., Jr.
Powell, Thomas
Purchard, Paul
Rambo, R. E.
Richardson, Lawrence
Robinson, G. P.
Schadt, A. D.
Schrontz, S. B.
Shives, W. H.
Smith, Sion B.
Stevenson, L. N.
Stotler, Harvey K.
Thomas, George P.
Walker, W. S.

PRESIDENT: The call of the roll will be dispensed with as we have a complete record of attendance in the registration cards.

The minutes of the last meeting have been printed and distributed to the members, and we will dispense with the reading of the minutes.

I will ask the Secretary to read the list of proposals for membership.

SECRETARY CONWAY: We have the following proposals for membership:

Byers, Thomas, general Agent, Delaware & Hudson Railroad, Koppers Building, Pittsburgh, Pa. Recommended by George R. Gardner.

Cunningham, H. B., Chief Engineer, Journal Lubricator Company, 939 West North Avenue, Pittsburgh, Pa. Recommended by Charles Orchard.

Hursh, Samuel R., Division Engineer, Pittsburgh Division, Pennsylvania Railroad Company, 1324 N. Sheridan Avenue, Pittsburgh, Pa. Recommended by S. L. Church.

Kentlein, John, Chief Draftsman, H. K. Porter Company, Hawthorne Road, Millvale, Pa. Recommended by Raymond E. Kraus.

Lillie, G. W., Sales Engineer, Union Steel Casting Company, Pittsburgh, Pa. Recommended by J. D. Conway.

Purchard, Paul, Engineer for Auto-Tite Joints Company, Park Building, Pittsburgh, Pa. Recommended by A. M. Frauenheim.

Thomas, George P., President, Thomas Spacing Machine Company, Glenshaw, Pa. Recommended by H. D. Webster.

PRESIDENT: In accordance with our By-Laws these proposals will be referred to the Executive Committee, and upon approval by that Committee the gentlemen will become members without further action of the Club.

SECRETARY: Since our last meeting we have received information of the death of two of our members. One of these is known to you all, and perhaps the other will be recalled by many of our members. Elisha Lee, Vice-President, Pennsylvania Railroad, Philadelphia, Pa., died August 6, 1933, and W. F. Deneke, Terminal Agent, B. & O. R. R., Pittsburgh, Pa., died August 20, 1933.

PRESIDENT: These gentlemen were very well known to many of the members of the Club and an appropriate memorial minute will appear in the next issue of the Proceedings.

The October meeting of the Club is the Annual Meeting

and the time for the annual election of officers. In accordance with the provisions of our By-laws I have appointed the following gentlemen as a Nominating Committee:

J. A. Warfel, Chairman,
William C. Hansen,
Charles Orchard.

I would request this Committee to retire at their early convenience and formulate a report to be presented later in the evening of nominations for officers for the ensuing year.

The Western Pennsylvania Safety Council has under way a three months campaign on safety. They have given it a very appropriate name, "The Better Times Safety Drive." During these several years of business depression the matter of safety has been somewhat neglected. In all our business establishments we have had a less volume of business and a smaller number of men employed at something less than full time schedule, conditions that make it very difficult to carry on very zealous safety work. In connection with the campaign of the Western Pennsylvania Safety Council we have a speaker tonight who will address us briefly on the subject, Mr. Grafton Duvall, of the Philadelphia Company.

Mr. Duvall then explained briefly the purpose of the drive and the Secretary then read the following Resolution which, upon motion, was unanimously adopted.

RESOLUTION

WHEREAS, the upturn in business and industrial activities, the return of hundreds of thousands of school children to their classrooms and the greater use of private automobiles and commercial trucks can be expected to provide greater and more numerous hazards in the streets and highways, in the plants and in the schools and homes, and

WHEREAS, the Western Pennsylvania Safety Council, with the co-operation of the State of Pennsylvania, the City of Pittsburgh, the various counties and cities in the Western part of the Commonwealth, is conducting a three months' safety campaign during September, October and November, to be known as "Better Times Safety Drive", and

WHEREAS, it is to the interest of each and every resident of Western Pennsylvania to support this movement in an effort to reduce accidents and fatalities of any and all sorts,

NOW THEREFORE WE, The Railway Club of Pittsburgh do hereby solemnly resolve in meeting assembled to lend our every support to the Western Pennsylvania Safety Council and its component parts to the end that our community will be a safer and happier place in which to live.

PRESIDENT: We thank you, Mr. Duvall. The Railway Club of Pittsburgh is very glad to go on record in support of this safety movement and this campaign of three months which is now on.

MR. C. O. DAMBACH: I would move the adoption of the resolution.

MR. HENRY F. GILG: I second the motion.

The motion prevailed by unanimous vote.

PRESIDENT: We come now to the subject for the evening, "Analysis of Equipment Maintenance" which will be presented by Mr. Lawrence Richardson, Mechanical Assistant to the Vice-President and General Manager, Boston & Maine Railroad. Mr. Richardson has made a very detailed and exhaustive study and analysis of equipment repairs and their costs and he has some exhibits and a discussion of that subject which will put it very graphically before us. Mr. Richardson has also served a term as President of the New England Railway Club, and we are very glad to welcome him in that capacity also. Mr. Richardson.

MR. LAWRENCE RICHARDSON: It gives me a great deal of pleasure to be with you tonight. My first Railway Club membership was in the Railway Club of Pittsburgh exactly twenty years ago. Coming here tonight, I recognize a lot of my old friends. You know it is not always so easy to recognize friends or countrymen. Last year when I was crossing the border going into Soviet Russia I had quite a time with the customs. They go through your baggage with a fine toothed comb, taking about an hour and a half at it. At that point German was the only language they could speak other than Russian. Not a person could speak a word of English. After I was passed, I went into the next room and there was a fellow sitting drinking a bottle of beer. He nodded to me and said "Guten abend" and I replied "Guten abend." He said "Wie geht es bei ihnen" and I said "Es ghet sehr gut, wie geht

es by ihnen?" He replied, "Sehr gut. Wo wohnen sie?" I said "Boston, U. S. A." He said "Me too."

I had a very pleasant afternoon going around Pittsburgh, today. You must admit that business is picking up again. I am reminded of the story of Maggie, who had just bought a new hat after four years of depression. As she was going home from church on Sunday it started to rain, and she lifted her skirt to her head to protect the hat. But instead of getting just her skirt she got hold of everything she had on, petticoats and everything. Somebody said "Pat, Maggie is exposing her rear." Pat turned to Maggie and said "Maggie, you are exposing your rear." She replied "The devil I care, I have had that rear for forty-one years but this hat is new."

But it is good to get back to Pittsburgh again. O. Henry wrote many excellent and entertaining stories about this old town. It has been my privilege to live in Chicago, New York, and Pittsburgh but I do not think there is any town in the country where the people are more democratic and friendly than they are here in the old Smoky City. It does my heart good to get back and be with you tonight.

As to the subject of the evening:

ANALYSIS OF EQUIPMENT MAINTENANCE

By LAWRENCE RICHARDSON,
Mechanical Assistant to Vice President and General Manager, Boston and Maine Railroad, Boston, Mass.

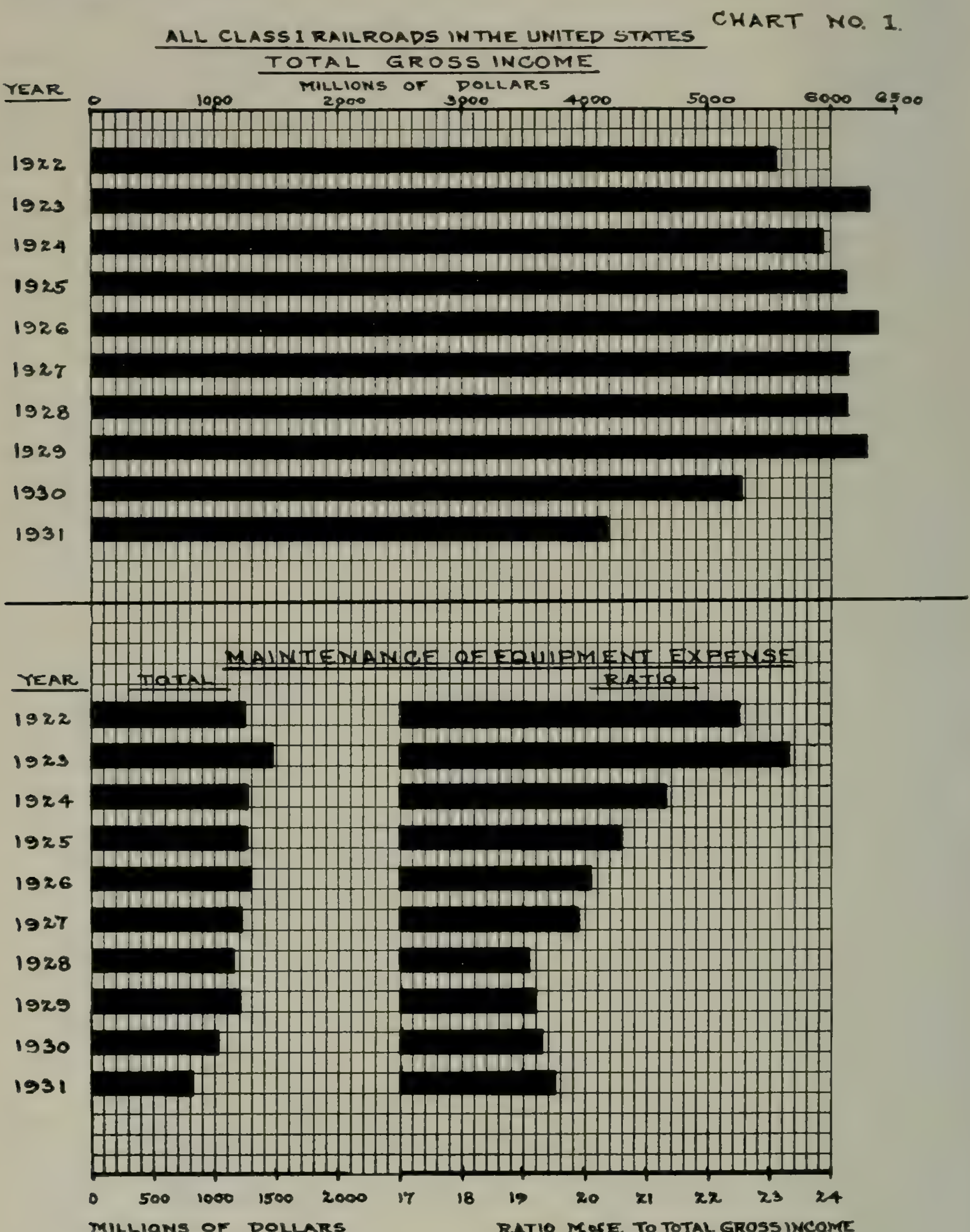
The Maintenance of Equipment account on all Class 1 American Railroads has averaged $1,200,000,000 annually for the past ten years. The magnitude of this amount can be appreciated when it is converted to a daily expenditure of $3,300,000. It is exceeded only by Transportation costs.

The subject is broad and covers many angles. Discussion will have to be confined to a general outline with some concrete examples.

In analyzing Equipment Maintenance for the last ten years and the corresponding gross income for the same period, the ratios existing between them show the benefits derived by the intensive drive to improve the general mechanical efficiency. These relations are shown graphically on Chart No. 1. Maintenance of Equipment expenses have decreased steadily, as the

ratio of M. of E. to gross income in 1922 was 22.5, while in 1928 it had been reduced to 19.1, a reduction of 15%.

The trend in gross income comparing 1922 and 1928 has been an increase of 10%. Stated in another way, out of a dol-



lar received in 1922 as gross income, \$.225 was spent for equipment repairs, while in 1928 out of the gross income dollar only \$.19 was spent for equipment maintenance.

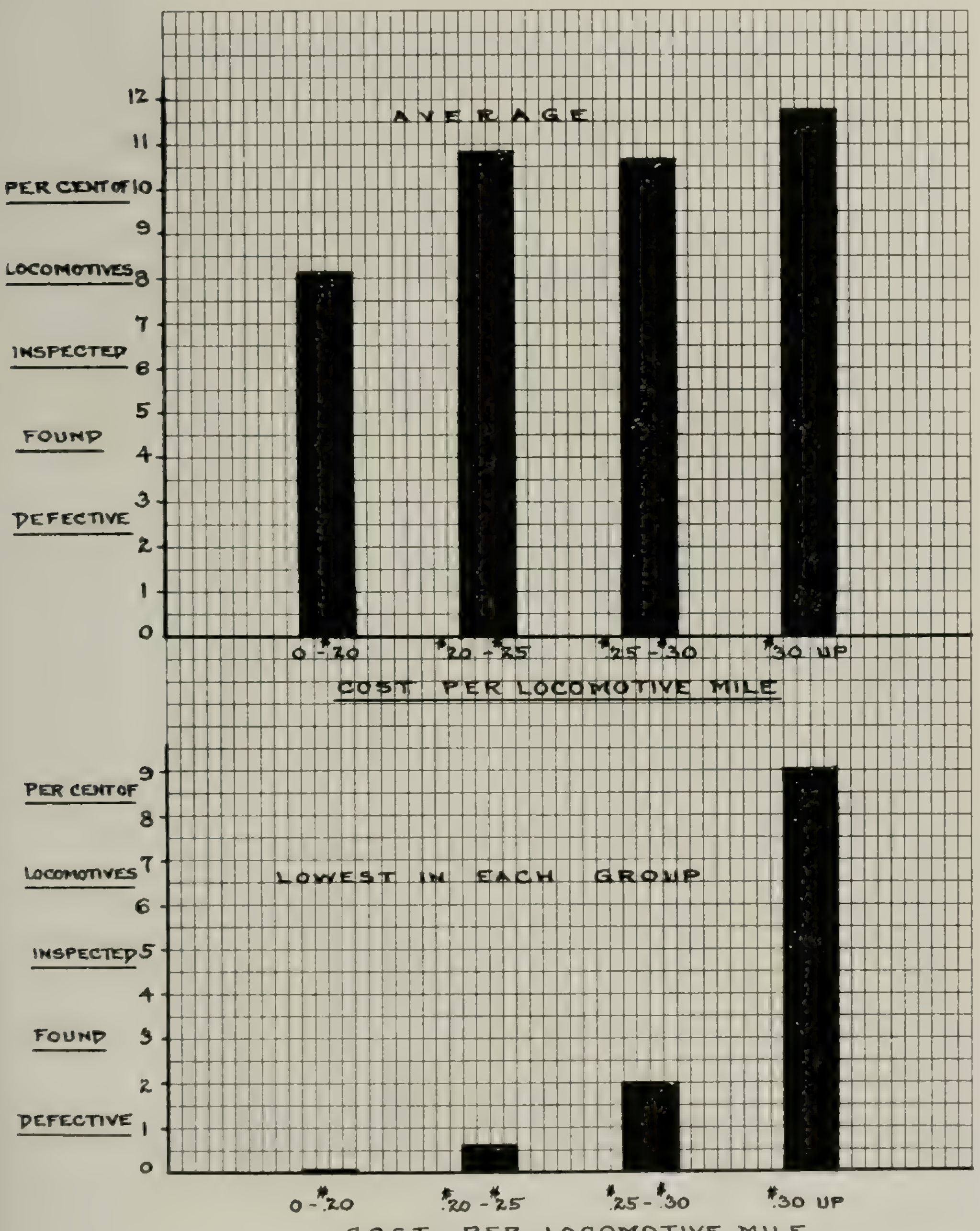
This decreased ratio meant a saving of over \$200,000,000 for 1928 as compared with 1922.

The ratio has increased slightly during the depression as

the use of equipment and the number of units have not dropped as much as has the income.

The gain from the reduced equipment maintenance expendi-

CHART NO. 2.

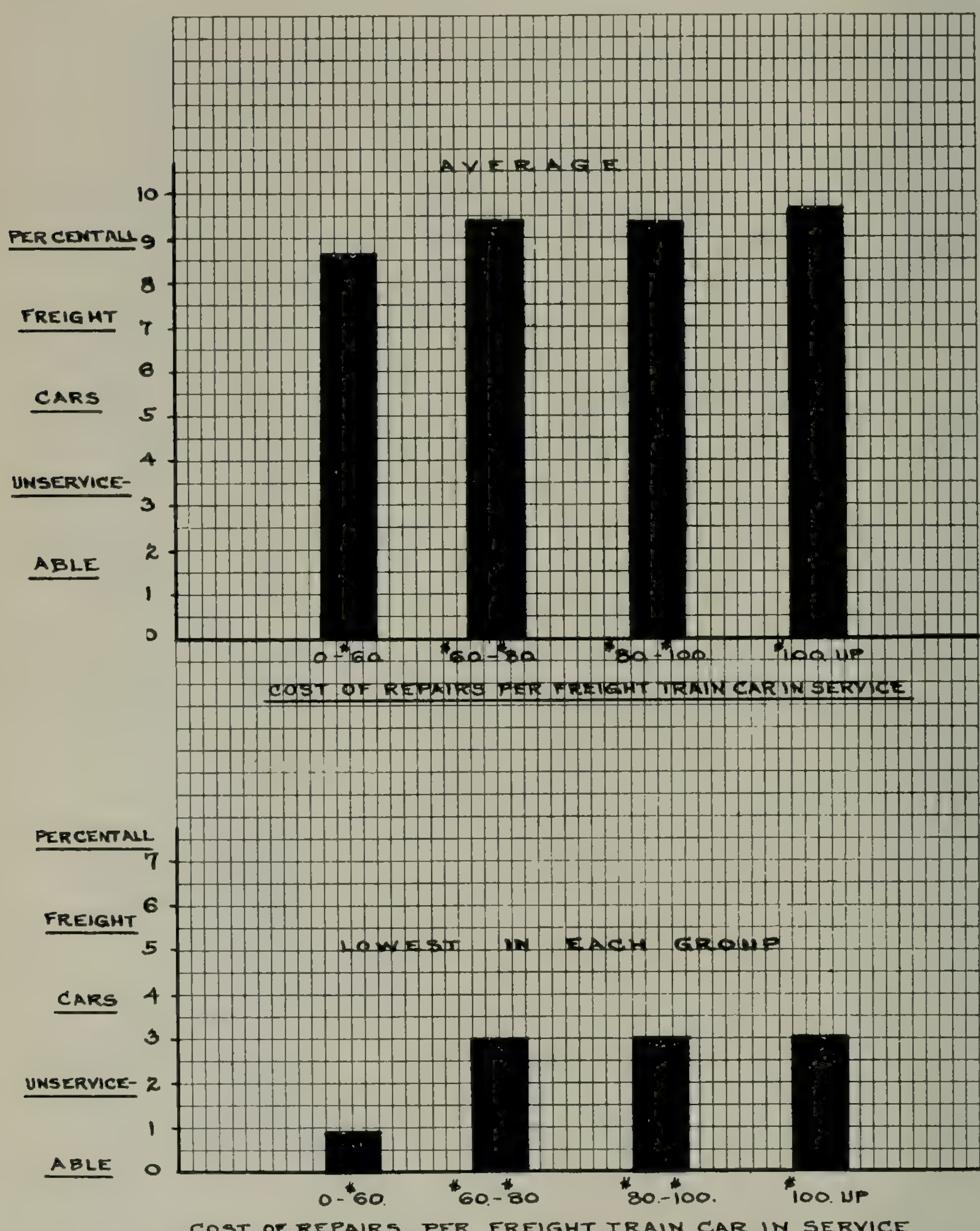


COST OF REPAIRS PER LOCOMOTIVE MILE COMPARED WITH PER CENT OF LOCOMOTIVES INSPECTED FOUND DEFECTIVE - 47 LARGEST R.Rs IN U.S - 1931.

tures has been entirely net, no additional expense being added to the other departments. In fact, conditions have been markedly improved as reflected by fewer locomotive and car failures. One of the most interesting facts brought out by an analysis of the Maintenance of Equipment expenditures for the 47 larg-

est railroads in the United States is that lowest costs are attended by a better condition of equipment. The fallacy that a good power and car condition costs money is refuted by Charts Nos. 2 and 3.

CHART NO. 3.



COST OF REPAIRS PER FREIGHT TRAIN CAR IN SERVICE COMPARED WITH PER CENT OF ALL FREIGHT CARS UNSERVICEABLE-47 LARGEST R.R.'s IN U.S.-1931.

In the locomotive chart, these railroads have been divided into four groups, arranged as to cost of repairs per locomotive mile, 0 to $.20, $.20 to $.25, $.25 to $.30 and $.30 up. The condition of power in each group was taken from federal reports.

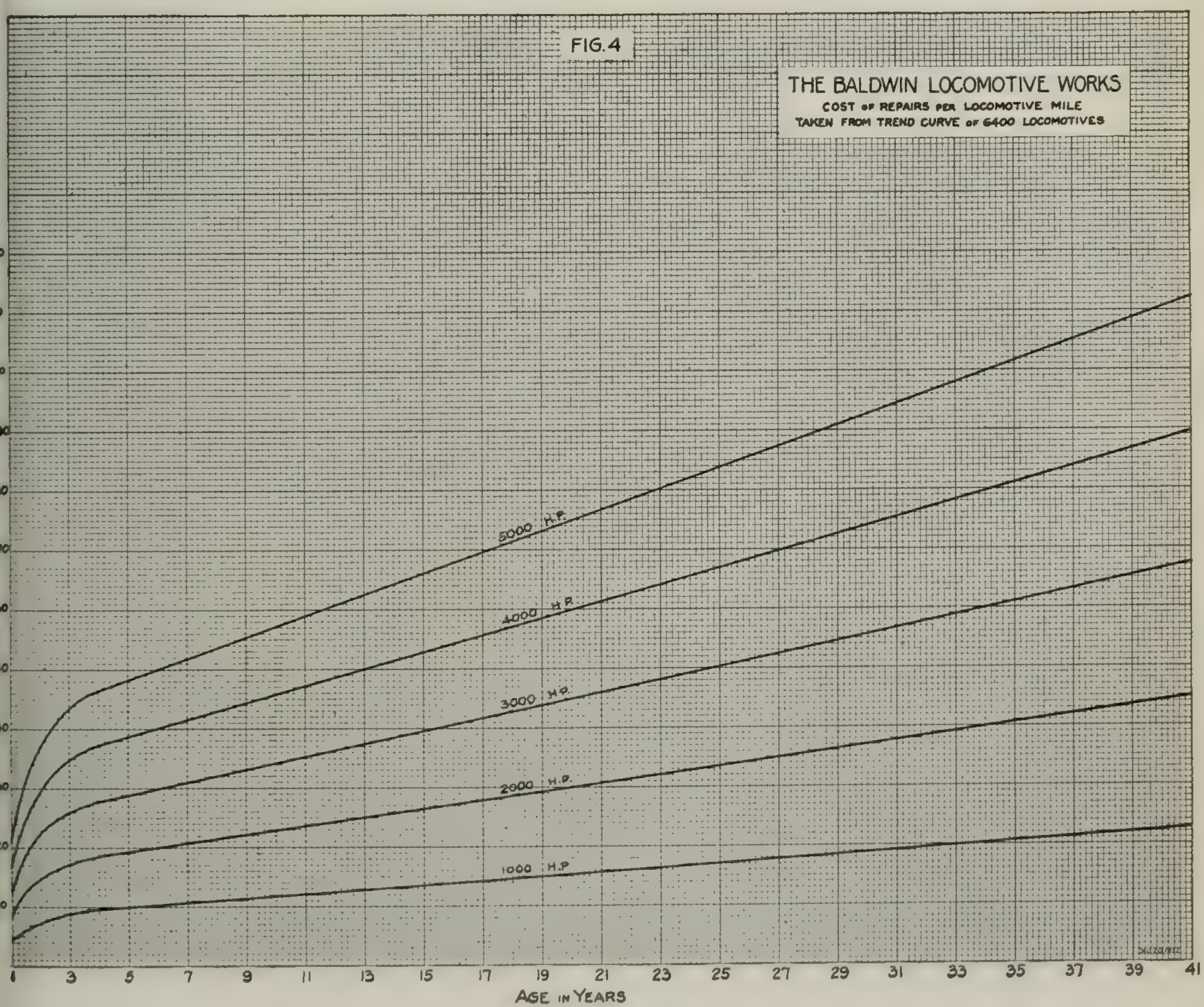
The average condition in the lowest cost group is the best, while that in the highest cost group is the worst. The leaders in each group show an even more striking relationship. The best condition in the highest cost group is 90 times the best in the lowest cost group.

The chart showing freight train car conditions reflects a similar condition. The costs and condition of cars have been taken from federal reports furnished by the Bureau of Statistics of the I. C. C. The lowest cost group is also the best condition group.

These charts of cost and condition explain the truth of E. H. Harriman's policy that: "A dollar saved by deferred maintenance brings about a subsequent expenditure of two dollars."

It is important that savings effected in mechanical maintenance be real economies and not result in a poorer condition that ultimately causes an actual loss.

In checking costs, it is important that the effect of age be not over-looked. Chart No. 4 shows the relationship existing be-



tween age and repair costs. It was developed by Mr. T. R. Cook, formerly a member of this Club. It will be seen that costs increase approximately 4% per year. One railroad may have locomotives costing 10% more than another, but if the age of the power exceeds the other by more than 2½ years, its record is actually better.

The transportation department has realized more than a full share of benefit from these conditions. Where a good hot-box record in 1922 was expressed in tens of thousands of miles, in 1932, it was expressed in hundreds of thousands of miles. Locomotive failures have decreased likewise. This has brought train delays, due to mechanical failure, to a minimum, resulting in faster movements and an almost complete elimination of overtime in through service. Fast freight train service has approached the reliability of passenger service.

The three primary factors supporting this improvement in equipment maintenance are:

(1) Higher degree of skill in labor.

(2) Improved design of equipment.

(3) Closer analysis of cost.

The advance in skill is the result of education and stabilization. Supervision plays as large a part in the former as does the man. The mechanic arts are constantly advancing. To keep supervisory forces abreast of the times, it is necessary to stimulate interest in railroad clubs and associations. Foreman training more than justifies itself in the results attained. An increased number of helpers have been advanced to journeymen. They must be fully schooled in their duties to properly perform the work assigned them. Stabilization has eased this problem somewhat as the reduced tournover meant fewer new men hired. Estimates of the cost of hiring a new man and breaking him in average $125.00, a direct charge which must be absorbed in cost.

Design has played its part in this improvement. A. R. A. Committees are constantly at work studying standards, and establishing specifications. This work brings about a reduction in the costs of maintenance. The supply concerns have more than contributed their share in the production of better materials and the development of specialties.

Research and test work have reduced failures and lengthened service. The draft gear and air brake tests conducted by the American Railway Association are two outstanding ex-

amples of co-ordinated research with an adequate program and personnel. The benefits to the member roads from these tests and developments have fully justified the efforts.

While general analyses are helpful, it requires an analysis in detail to accomplish the best results. It is not sufficient to know that maintenance in general is high. One must know what parts or members are not giving economical service. But a detailed individual cost accounting of freight cars entails a prohibitive cost, just the same as a test of every bar of steel. To get this desirable information at a reasonable cost, a system was devised to analyze a small number carefully and use this information as a control of the whole series.

Twenty-five cars out of each series were stencilled "M. T. C." To the repairman, they are, to all intents and purposes, foreign cars. He makes an A. R. A. bill for every job. These

CHART NO. 5

BOSTON AND MAINE RAILROAD — MECHANICAL DEPARTMENT

FREIGHT CAR M.T.C. MAINTENANCE STUDY — ONE YEAR PERIOD MARCH 1, 1932 TO MARCH 1, 1933

No.	ITEM	1 BOX SUF CAPACITY 60,000	2 BOX SUF CAPACITY 80,000	3 BOX DS-SUF USRA	4 BOX SS-SUF ARA	5 FLAT SUF	6 GOND COMP SUF CAPACITY 100,000	7 HOPPER ALL STEEL CAPACITY 140,000	8 REFRIG SUF
1	WHEEL CHANGES	$ 72.60	$ 37.97	$ 175.34	$ 13.40	$ 215.53	$ 126.40	$ 25.55	$ 182.34
2	JOURNAL BOXES	8.99	1.32	12.39	2.27	2.29	15.82	—	17.65
3	JOURNAL BEARINGS	13.02	17.78	12.67	7.84	17.38	26.31	6.44	22.14
4	BRAKE BEAMS	5.15	.35	22.85	19.40	—	3.55	—	27.18
5	BRAKE SHOES	8.72	12.73	17.59	3.77	5.51	11.40	.56	86.57
6	TRUCK PARTS	35.23	182.30	2.41	23.13	6.70	32.49	—	228.94
7	BRAKE RIGGING	4.86	10.60	1.90	15.48	7.75	7.30	.40	12.68
8	TRAIN LINE	7.86	16.92	14.62	1.02	20.34	32.88	1.33	104.49
9	AIR HOSE	9.90	24.75	21.45	28.05	27.42	13.20	23.10	146.85
10	ANGLE COCKS	4.05	2.70	2.70	—	7.95	6.27	1.35	17.55
11	AIR BRAKE CLEANING	86.82	86.10	91.31	90.47	77.24	91.07	110.95	27.75
12	HAND BRAKE	—	2.70	3.48	—	21.22	8.65	—	.90
13	SILL STEPS, ETC.	16.47	14.87	22.61	1.50	15.04	12.40	1.71	15.89
14	DRAFT GEAR	106.85	4.80	1.10	81.09	29.15	.20	2.10	23.21
15	COUPLERS	46.21	91.32	43.83	5.82	.87	6.37	—	19.29
16	YOKES	11.80	16.60	68.10	—	—	—	—	—
17	BODY	27.88	26.31	48.20	54.91	.90	15.17	—	72.36
18	DOORS	26.78	70.36	115.01	2.65	—	—	—	46.54
19	HOPPER	—	—	—	—	—	18.13	2.87	—
20	FLOOR	—	—	8.13	2.35	119.26	275.58		1.54
21	LINING	13.35	33.90	31.74	9.79	—	—	—	.54
22	UNDER FRAME	.55	—	.20	.20	—	—	—	.95
23	CENTER PLATES	12.46	16.00	5.50	3.73	2.90	—	—	—
24	MISCELLANEOUS	37.80	41.70	75.75	34.25	74.65	57.30	80.60	302.40
25	TOTAL CHARGES	$ 557.35	$ 712.08	$ 798.88	$ 401.12	$ 651.20	$ 760.49	$ 256.96	$ 1357.71
26	NUMBER OF CARS INVOLVED	25	24	26	25	25	25	25	25
27	NUMBER OF CAR DAYS HOME	8522	8121	8158	7414	7964	8068	8161	7263
28	NUMBER OF CAR DAYS FOREIGN	603	639	1332	1711	1161	1057	964	37
28	NUMBER OF CAR DAYS TOTAL	9125	8760	9490	9125	9125	9125	9125	7310
30	PERCENT HOME DAYS	94	93	86	81	87	88	89	99
31	PERCENT FOREIGN DAYS	6	7	14	19	13	12	11	1
32	MAINTENANCE PER CAR DAY HOME	$ .059	$ .072	$ .085	$ .041	$ .055	$ .084	$ .029	$ .191
33	MAINTENANCE PER CAR DAY FOREIGN	$ .088	$ .148	$ .081	$ .055	$ .175	$ .081	$ .020	$ —
34	MAINTENANCE PER CAR DAY TOTAL	$ .061	$ .081	$ .084	$ .044	$ .071	$ .083	$ .028	$ .191
35	AVERAGE AGE OF CARS	24	21	14	3	10	14	4	26

bills are sorted out as they pass through the A. R. A. Billing Bureau and turned over for compilation and accounting.

Chart No. 5 shows the costs of running repairs only for a twelve months period. The general design of the cars is indicated at the top of each column. The figures are self-explanatory. The detail is sufficient to answer questions raised as to performances of individual parts.

Of particular interest are the columns for A. R. A. single sheathed box cars and all steel hoppers. The excellence of the design of these cars is quite readily noted. Trips to the repair tracks are few and far between. When a shipper loads one of these cars he has an assurance that his load will go through

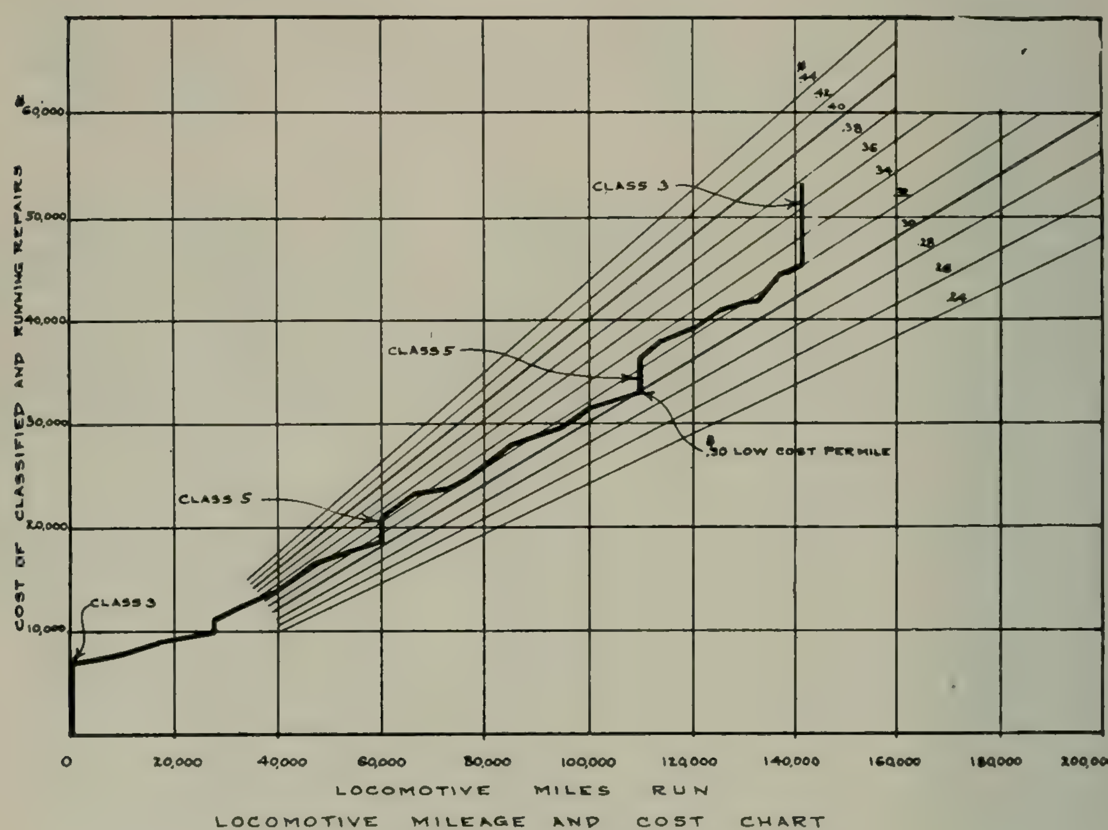


CHART NO. 6.

to destination without being delayed on repair tracks. The principal items of cost are those involving periodical work, principally air brake cleaning and journal repacking. The new "AB" brake is solving one problem. Research now under way will minimize the other problem. Cast steel has already eliminated other causes. The cost of truck parts for these cars to date is nothing. ($0.00) Compare this record with arch bar and other types of built-up trucks. Such performance assures the safest possible operation.

A study of these costs over a period of years has developed the necessity and economy of doing a complete job when cars are in the shop for general repairs. Failure to do the required work at such times is not economy in any sense of the word. The bills show that such jobs are only deferred at multiplied costs.

Designers will find these figures are splendid guides for their efforts. They point out the particular items that need attention and betterment. In answering them, costs are lowered and service bettered.

Chart No. 6 is a locomotive mileage and cost record which is possible to keep up-to-date with a surprisingly small amount of clerical work. Locomotive miles run are used as a base and cost of classified and running repairs in dollars as ordinates. Radial lines are drawn for each locomotive repair cost per mile. There is a 26c line, a 28c line, 30c line and so on. The lines are readily drawn by the determination of a single point. With that and zero as the other point, a straight line is drawn. An average cost of 30c per mile at 50,000 miles would be $15,000. At 100,000 miles it would be $30,000. A check of each straight line will show the same relation to hold at any other point.

The cost record of an individual locomotive is shown on the chart. It starts with the cost of a class 3 repairs at zero mileage, running costs and mileage being added monthly. It is essentially a curve of total cost versus total mileage. It is continued until the next general shopping. The curve shown covers an actual case and shows the loss of running too great a mileage before shopping for general repairs. There were two class 5 repairs, one at 60,000 miles and the other at 110,000 miles. The cost at 60,000 miles was 31c per mile. The class 5 repair at this point fully justified itself because the cost dropped to 30c at 110,000 miles. However, the class 5 repair at this point did not justify itself because the cost only dropped back to 32c at 142,000 miles, when it was necessary to shop the locomotive for a class 3 repair. The actual loss was 2c per mile over the entire 142,000 miles, or $2,840.

With charts of each locomotive periodically checked for excess cost per mile, they are particularly useful in determining the economical mileage of each class as well as the proper shopping of each individual locomotive.

Figure 7 shows the reverse side of the card with a record of the monthly mileage and monthly running and classified re-

pair costs added, the totals only being posted on the chart. Record is also maintained of the classified repairs by points and the total cost of each repair.

The future of mechanical maintenance is challenging. Competition is becoming more pressing, demanding lowered costs. As in the past, the mechanical department must carry its full share of the load.

Average labor rates in mechanical maintenance are high,

LOCOMOTIVE NUMBER 7304. DIVISION ____________. CLASS ____________.

Month	Year 1929		Year 1930		Year 1931		Year 1932		Record of Heavy Repairs			
	Repairs	Miles	Repairs	Miles	Repairs	Miles	Repairs	Miles	Class	Shop	Cost	Miles
Jan	\$		\$ 662	3764	\$ 648	4864	\$ 640	2584	3 6-'29	B.ll	\$ 7190	
			10226	26308	26860	82976	40380	125024	½ 2-'30	EP	1376	
Feb			1976	4652	964	4656	802	2696	5 8-'30	B.ll	2844	60,000
			12202	30960	27824	87632	41182	127720	5 7-'31	B.ll	2646	110,000
Mar			1501	4794	1076	4884	598	2884	3 9-'32	B.ll	8458	142,000
			13703	35754	28900	92516	41780	130604				
Apr			996	5780	1378	5136	562	2646				
			14699	41534	30278	97652	42342	133250				
May			966	6024	1530	5064	624	2040				
			15665	47558	31808	102716	42966	135290				
Jun			919	4860	1156	4936	688	1964				
			16584	52418	32964	107652	43654	137254				
Jul	7460	3934	1204	5780	3246	2100	582	2460				
	7460	3934	17788	58198	36210	109752	44236	139714				
Aug	416	3564	3256	1802	664	2894	574	2282				
	7876	7498	21044	60000	36874	112646	44810	141996				
Sep	340	3736	840	4540	816	2640						
	8216	11234	21884	64540	37690	115286						
Oct	384	3446	1370	4002	594	2256						
	8600	14680	23254	68542	38284	117542						
Nov	446	3364	1354	4684	618	2058						
	9046	18044	24608	73226	38902	119600						
Dec	518	4500	1604	4886	838	2840						
	9564	22544	26212	78112	39740	122440						

LOCOMOTIVE MILEAGE AND COST DATA CARD

CHART NO. 7.

being only exceeded by three other groups according to Department of Labor reports. This means that maximum production and efficiency must be attained to hold our own with lower paid competitive groups. This calls for the best of engineering and planning. It can be done. Mechanical men have successfully met their problems in the past and will continue to meet and solve them as they arise.

A fuller appreciation of mechanical problems by the higher executives will be helpful. Proper backing and an adequate share of capital expenditures will enable mechanical men to do their part. The standard of living in any nation is based on the industrial development of that nation. A high state of mechanical development means a high standard of living. The same is true of individual railroads.

PRESIDENT: The discussion the speaker has given us on this question of repairs to equipment has been very well received and very interesting to every one here and I know it will call forth a good deal of discussion. And I think Mr. Richardson will be glad to answer any questions that may be addressed to him.

MR. GUY M. GRAY: May I ask whether the charts and tables shown on the screen will be printed in the Proceedings along with the paper, so we may have opportunity to study them?

PRESIDENT: Yes, sir, they will be printed.

Mr. Flinn, have you anything to say on the subject?

MR. R. H. FLINN: Mr. President, I am sorry you called on me first because I wanted to say something but I was in hopes that some of our mechanical men would get up and say something before I had to do it. Frankly I can not take any exception to anything Mr. Richardson has said because I have to agree with every bit of it. The subject is too complicated for me to discuss in any concrete form. Without attempting to quote figures I know that every railroad I have any knowledge of has been conducting quite a strenuous campaign for the reduction of maintenance expenditures in the last few years and that has not been accomplished by the sacrifice of the condition or the performance of the equipment on the road.

You will see a great deal in railroad publications regarding the studies of the Federal Co-ordinator of Transportation in connection with equipment and he has in mind some of the very things Mr. Richardson had in mind in connection with the cost of repairs to equipment. It is a very simple solution of the problem to say that the way to help national recovery from the depression is to create a demand for more purchases on the part of the railroads. But the railroads would not have hesitated to buy if they could get the money to buy with. As a matter of fact the purchase of modern equipment would immediately pay the railroads substantial returns. A good many types of equipment are expensive to operate and maintain and they have been continued in use simply because we have not been able to get the money to buy modern equipment. We used to think a locomotive had to run twenty-five years before it was worn out. It is common knowledge now that a

locomotive will become practically obsolete in ten years in the service you have to meet in modern transportation.

I saw something the other day which our speaker might comment on a little later, that is the question regarding the effect of increased speed on cost of repairs of equipment. From statistics of freight train speed and train load you will find a very substantial increase in the past few years. The question was raised as to what effect that would have on the cost of repairs of equipment. Of course at first blush you might think the increase in speed would increase the cost of repairs. In my own personal opinion it hasn't anything to do with it. In fact I think it has a tendency to reduce the unit, cost of repairs, keeping in mind of course that there are certain limits within which we must work. When we speak of high speed today it is not an increase in the speed of the actual operation of the locomotive but rather a decrease in delays which enable a higher statistical speed. It is due to the fact that we have eliminated delays and increased the length of runs and by other modern operating methods we have got very much better performance out of the equipment. I will ask Mr. Richardson if he will not comment on that.

The general subject of railroad operation is very much tied together with the mechanical department and you can not have successful railroad operation unless you have efficient operation of the mechanical department. I think the best maintenance is the cheapest maintenance not only for the mechanical department but for the operating department and therefore for the railroad as a whole.

PRESIDENT: Mr. Lynn, of the P. & L. E., what can you say?

MR. SAMUEL LYNN: Mr. Chairman and fellow members: It has been my privilege to know Mr. Richardson for quite a number of years and I know when he makes a statement he has the data to back it up.

I was very much interested in the figures he presented showing costs on freight car maintenance. However, the mechanical men present know, (I am speaking now particularly of car equipment) that there is a certain period in the life of freight cars where the maintenance cost is low. However, after the equipment gets to a certain age, (I am now speaking of steel cars) the maintenance cost, particularly when heavy re-

pairs are necessary, requires a considerable expenditure, and it is a question in my mind as to whether the cars that are in continuous service will not continue in service longer than the cars that are placed in storage on side tracks because of not being needed.

Mr. Richardson, if I have his figures correctly, was stressing largely the maintenance cost for running and possibly medium repairs. I do not have any information on hand as to the average cost of running repairs on freight cars. However, it has been our experience in this territory, in making heavy repairs to steel equipment, that it is necessary to get into maintenance repairs after the first 8½ to 10 years of the life of the car, and when cars begin to come in for this class of repairs, the maintenance cost increases rapidly.

There has been a big improvement in the manner of handling classified repairs over the method in which it was handled a few years ago. After the war practically all of the Railroads had a large number of cars in bad order and in order to get the cars repaired and put back into service, a change was made in the method of handling the repairs. Prior to the time I speak of, regardless of the type or condition of the car, it was the practice to start a couple of repairmen on the car and let them go ahead and complete the repairs. However, because of the large number of cars defective and the need for the equipment, the progressive system of repairs was inaugurated. This resulted in taking cars into the shop by series, having different gangs of men perform the same operations on each car. In this way the material needed for the repairs was placed in certain locations in the shop and because of the experience the men received in performing only the one operation they became very efficient on their particular job, which resulted in a considerable reduction in maintenance cost over the previous method of handling our work. I assume that most of the Mechanical men, both in the Locomotive and Car Departments, are familiar with the system of repairs of which I am talking, i. e., the moving of the car from one track position to another on the classified repair jobs. It is our opinion that this method of doing the work, making the proper repairs to the car rather than applying a patch here and there, has had the effect of reducing our costs considerably over our former method.

PRESIDENT: Mr. Richardson made some mention of the A. B. air brake. I wonder if any of the air brake people here would say something in elaboration of that, as to how it might affect car maintenance costs. Mr. Wright?

MR. JOHN B. WRIGHT: We anticipate marked savings in maintenance expense with the "AB" brake over costs to date by reason of the protection against dirt and moisture that has been incorporated in the design. Special effort was made in the development of the "AB" brake to incorporate the most advanced principles of design, based upon many years of practical experience and engineering knowledge. It remains to be seen just how much longer time it can remain in service without attention, but we anticipate that the period between cleaning dates can be very materially lengthened.

PRESIDENT: Prof. Endsley, have you any comments?

PROF. LOUIS E. ENDSLEY: I always have some comments to make when a boy gets up here who was a student under me twenty years ago. I knew at that time that he would go far. He was a student, he wanted detailed facts. I did not see anything of him until he had some results, and he would work all night on it. And when he had thought it through he knew all about it. When he speaks of testing twenty-five cars out of a thousand to fix a standard for them all, it is like eating twenty-five pies out of a thousand. If they are good you can be pretty sure the rest of them are good. I am glad to be here tonight and I know we have all enjoyed listening to the paper. He has given us some information in this paper that I know we are all going to study. I think Mr. Richardson is to be congratulated on what he has given us tonight.

PRESIDENT: I think we ought to get the point of view of the man who uses cars. Mr. Dambach, will you give us something on that?

MR. C. O. DAMBACH: I have not any comments to make but I would like to ask Mr. Richardson a question, that is this —Since a great many railroads are changing their policy by charging equipment retirements to Profit and Loss instead of to Operating Expense, I was wondering whether this would distort Maintenance figures to any great extent.

MR. RICHARDSON · That will distort it to some extent, because the matter of retirements, which are ordinarily charged to profit and loss, will produce a result that is at variance with those roads which have charged thousands of dollars to car retirements. On the B. & M. there was one year we charged almost $3,000,000 to our maintenance expenditures simply by reason of our retirement of equipment.

PRESIDENT: Our discussion so far has been mostly of the car. There was a very interesting chart in regard to locomotives. Will some of the locomotive men have anything to say? Mr. Berg, of the P. & L. E.?

MR. K. BERG: I was trying to sink down in my chair, hoping I would not be called upon tonight. I have known Mr. Richardson for many years, and know very well that he is familiar with his subject, and it is impossible for me to take any exceptions to what he has said, nor does it seem possible to make any constructive comments.

I know, of course, that conditions differ on different railroads in regard to the necessity of heavy repairs, and the time between general shoppings. There might also be many questions with reference to purchase cost of material, as well as the reclaimed material.

There is a great variation of opinion as to the advisability of reclaiming material. There is also a question as to the wisdom of continuing the repairs to locomotives in kind, particularly with reference to the application of modern specialties, etc. Various limits of cost have been decided upon with reference to absoleting equipment rather than repairing same.

The New York Central Lines, for example, have established repair limits to various classes of their locomotives, which we follow on the Pittsburgh & Lake Erie Railroad.

There has of late years been an increased demand on the Mechanical Departments account of continual reduction in number of units of locomotives, and at the same time, transporting greater tonnage. This, of course, as stated by Mr. Flinn, is accomplished through co-operation with the Transportation Department. The difference in tonnage hauled, per unit, however, has a great deal to do with the cost of repairs. I also know that the co-ordination or concentration of various repairs, application of new specialties, government tests, etc., are great factors in reduction of costs.

As stated in the beginning, the whole question is a complex one and it is very hard for me to offer any constructive comments in addition to the information given us by the speaker.

PRESIDENT: If there are no further questions at this time, I wonder if Mr. Richardson would not make replies to the questions that have been asked.

MR. RICHARDSON: Mr. Flinn's first remarks about speed; in our experience, that is a matter that does not amount to very much, that is in freight car speed. The only excess maintenance that may be experienced will come from vertical vibrations at higher speeds. The use of non-harmonic springs on snubbers will eliminate any excess maintenance. Locomotive maintenance is normal when they are used up to their proper speed. But when you go beyond that, of course, maintenance does become excessive. However, Mr. Flinn takes the proper view that it is average speed that counts. It is the fellow that goes steadily along that makes the time. Speed does play some part in locomotive cost. I remember at one time we were purchasing some switching locomotives and wanted alloy frames in these locomotives. The President said, "How many frames break in this service?" I did not know. In checking up on it, I was very much surprised to find that in two years we had not broken a single frame under shifting locomotives. We had broken over 100 in road locomotives.

Mr. Lynn made a very good point about periodical maintenance and adequate repairs when shopping cars. It does play its part, but in the matter of freight car repairs it does not play so important a part as design. You take the U. S. R. R. A. side frames and bolsters which were in the U. S. R. R. A. design in 1918 and 1919; there are no repairs on those even today. For the U. S. R. R. A. box cars built in 1918 the truck parts only amounted to $2.41 for the whole 25 cars for the year in question. The same is going to be true of draft gears and other important parts. It is all going to come back to the heavy classified repair. Your experience checks our experience exactly; that is, the longer you can make the period between classified repairs, the more economical will be your maintenance. But when you make the repairs, you must make a good 100% job of it. You can't string it out with a half

job or it will be back inside of a year and the cost will mount up higher than ever.

Mr. Endsley's remarks about the twenty-five pies as a sample of the lot of 1,000 make me homesick. In New England homes, we have lots of pie, even for Sunday breakfast.

MR. G. A. MACDONALD: I have enjoyed Mr. Richardson's talk very much. I would like to ask one question. How do the maintenance figures compare on steam locomotives as against Diesel electric locomotives of comparable capacity in switching and transfer service.

MR. RICHARDSON: We have no Diesels in service. The information we have as to Diesels in service is very favorable to the Diesels.

PRESIDENT: We have a friend with us tonight whom we have not seen at our meetings for some time, a past President of this Club, Mr. J. G. Code. I do not know whether you have anything to add to this discussion, Mr. Code, but I am sure we would be glad to hear from you.

MR. J. G. CODE: I have no idea that I could add anything to the discussion. It is a pleasure to be here tonight and to greet so many of the old-timers in the Railway Club of Pittsburgh. One of the older poets took a walk with the Devil one day and tells of it in this fashion:

"We passed a cottage with a double coach house,
A cottage of gentility;
And He said with a grin,
That his favorite sin,
Is pride, that apes humility."

I am proud of the Railway Club of Pittsburgh, proud of its history—proud of its service to the railroads, and proud of those old-timers whose vision and energy made it a going concern. The Railway Club has accomplished important service always. It has even had a Brain Trust one Professor any way long before that became a national joke. I am proud of it, I admit it. Though the devil may get me in the long run, it will not be on the score of false humility.

PRESIDENT: We are very glad to have your encouragement and hope to see you here often.

Is there anything more?

MR. J. H. GLENN, ROAD FOREMAN OF ENGINES, THE PITTSBURGH & WEST VIRGINIA RAILWAY COMPANY: It happened to be my good fortune to ride several locomotives on the B. & M. Railroad last March and I was greatly impressed by the good condition of their locomotives. I don't think I ever rode an engine that could come up to a higher degree of efficiency than those locomotives on the B. & M. I noticed in their shop work they took great pains to take care of the small items on their locomotives; every little detail was taken care of.

On one of these runs from Mechanicsville to Boston—I believe it was called RB No. 2—we left Mechanicsville at 8:35 a. m. and, to the best of my recollection, we had about 4,000 tons, 75 cars, with a Lima type locomotive. There is quite a grade out of Mechanicsville; in fact, it could almost be termed mountainous. However, the engine handled the train perfectly.

At East Deerfield the train was stopped to take coal and water. Engine crews change at this point but the engine continues on with train to Boston. We arrived in Boston at 4:00 p. m., a distance of about 210 miles from Mechanicsville.

On arrival at Boston the engine crew had no work to report on the locomotive. However, the Engine Inspector carefully inspected the locomotive and reported a few minor defects, all of which were taken care of before the engine was again offered for service.

I noticed from the Roundhouse records that the engineers' reports were blank. However, the Inspectors' reports covered minor detail work which had to be taken care of and I was surprised to see that even some of the small or seemingly insignificant things reported by the Inspectors received such minutely close attention by the Foreman and the mechanics. The engines were certainly put in first class condition to perform first class service before being dispatched. This trip seemed to be no exception to the common practice.

I have often heard it said that no railroad maintains all its engines in good condition all the time but after riding a number of B. & M. engines I have come to the conclusion that the B. & M. railroad comes nearer to maintaining their power at 100% condition than any other road I know of. This is, no doubt, in a large measure responsible for their low cost per locomotive mile.

PRESIDENT: I do not desire to close the discussion if any one has anything more to say, but if not, I would like to call for a report of the Nominating Committee at this time.

The Nominating Committee submitted the following:

FOR PRESIDENT—C. O. Dambach, General Manager, P. & W. Va. Ry. Co., Pittsburgh, Pa.

FOR FIRST VICE PRESIDENT—R. H. Flinn, General Superintendent, Pennsylvania Railroad, Pittsburgh, Pa.

FOR SECOND VICE PRESIDENT—Curtis M. Yohe, Vice President, P. & L. E. R. R. Co., Pittsburgh, Pa.

FOR SECRETARY—J. D. Conway.

FOR TREASURER—E. J. Searles, Manager, Schaefer Equipment Company, Pittsburgh, Pa.

EXECUTIVE COMMITTEE—(Ten to Elect).

Frank J. Lanahan, Chairman,
A. Stucki,
Samuel Lynn,
D. F. Crawford,
G. W. Wildin,
W. S. McAbee,
E. W. Smith,
Prof. Louis E. Endsley,
John E. Hughes,
F. I. Snyder.

SUBJECT COMMITTEE—(One to Elect).

3 years John B. Wright, Assistant Vice President, Westinghouse Air Brake Company, Wilmerding, Pa.

RECEPTION COMMITTEE—(Five to Elect).

2 years H. E. Graham, Assistant to President and General Traffic Manager, Jones & Laughlin Steel Company, Pittsburgh, Pa.

3 years J. B. Baker, Chief Engineer, Maintenance of Way, Pennsylvania Railroad, Pittsburgh, Pa.

3 years Colonel Walter C. Sanders, General Manager, Railway Division, Timken Roller Bearing Company, Canton, O.

3 years G. A. Blackmore, President and General Manager, Union Switch & Signal Company, Swissvale, Pa.

3 years J. S. Lanahan, Vice President, Fort Pitt Malleable Iron Company, Pittsburgh, Pa.

ENTERTAINMENT COMMITTEE—(Two to Elect).

2 years H. W. Jones, General Superintendent Motive Power, Pennsylvania Railroad, Pittsburgh, Pa.

3 years James R. Geddes, Vice President and General Superintendent, Monongahela Connecting Railroad Company, Pittsburgh, Pa.

FINANCE COMMITTEE—(Four to Elect).

2 years E. Emery, Railway Supplies, 6511 Darlington Road, Pittsburgh, Pa.

2 years Harold F. Dunbar, Sales Representative, McConway & Torley Corporation, Pittsburgh, Pa.

3 years E. A. Rauschart, Mechanical Superintendent, Montour Railroad, Coraopolis, Pa.

3 years J. L. O'Toole, Assistant to General Manager, P. & L. E. R. R. Co., Pittsburgh, Pa.

MEMBERSHIP COMMITTEE—(Five to Elect).

2 years T. F. Sheridan, Assistant to S. M. P. & S. R. S., P. & L. E. R. R. Co., McKees Rocks, Pa.

2 years Donald O. Moore, Manager Traffic Division, Pittsburgh Chamber of Commerce, Pittsburgh, Pa.

3 years A. B. Severn, Sales Engineer, A. Stucki Company, Pittsburgh, Pa.

3 years W. P. Buffington, Traffic Manager, Pittsburgh Coal Company, Pittsburgh, Pa.

3 years Joseph H. Kummer, General Sales Representative, Fort Pitt Malleable Iron Company, Pittsburgh, Pa.

PRESIDENT: What is your pleasure? Are there any further nominations?

ON MOTION of Mr. C. O. Dambach, seconded by Mr. A. Stucki, the Report of the Committee is adopted.

PRESIDENT: In accordance with our rules these nominations will be submitted to the membership by letter ballot, the result to be reported at the October meeting.

I would like to say now that we are starting the new year's work we would like to arouse the interest of all the members in building up the membership of the Club somewhat. We have gone through a hard year but I believe we have cause for considerable encouragement. We do have a good club and we give you good value for the $3.00 a year it costs. After

adjournment we will have the usual luncheon in the rear of the room. Is there anything else that should come before the Club at this time?

MR. R. P. FORSBERG: If Mr. Richardson had presented a paper entitled, "Analysis of Maintenance of Way and Structures Expenditures," instead of "Analysis of Equipment Repairs," I could have followed him a little more intelligently as my experience has been largely in the former line of work. However, he has been so clear and lucid in the presentation of his theme that I am sure each one of us, whether we are interested in equipment repairs or not, have profited by listening to his paper, for he has given us basic or fundamental methods of making a proper analysis that we can readily apply to our own line of endeavor.

As I add from year to year to my own store of experience in railroad construction and maintenance, I am ever impressed with the value of making a proper analysis of the work I have done in the past which information serves as an invaluable guide for the conduct of my work in the future.

As Chairman of our Subject Committee, I wrote to Mr. Richardson last April and invited him to favor our Club with a paper at its May meeting and suggested to him that as the time was rather short in which to prepare a new paper it would be perfectly satisfactory to our Committee if he would use a paper that we understood he had presented a short time before to The New England Railway Club. Mr. Richardson replied that he would willingly carry out the wishes of our Committee, but if he were allowed to make his choice he would prefer to prepare an entirely new paper as he felt The Railway Club of Pittsburgh, which was his Mother Club, he having been a member during his former residence in Pittsburgh, deserved the best he had in him and he would gladly prepare a new paper if we would give him a little more time.

Our Committee gladly accepted his suggestion and I am of the opinion that everyone in this room tonight, who has followed him closely in the presentation of his paper, "Analysis of Equipment Repairs," feels that we made a wise decision.

Mr. Chairman it is my pleasure to move that by a rising vote we extend to Mr. Richardson our sincere thanks and our deep appreciation for the instructive and really worth while paper he has given us this evening.

The motion was duly seconded and carried by a unanimous vote.

MR. RICHARDSON: I thank you, I assure you it has been a real pleasure to be with you this evening.

There being no further business,

ON MOTION the meeting was adjourned.

J. D. CONWAY, Secretary.

In Memoriam

ELISHA LEE

Joined Club January 24, 1924

Died August 6, 1933

E. F. DENEKE

Joined Club April 23, 1931

Died August 20, 1933

OFFICIAL PROCEEDINGS

RAILWAY CLUB OF PITTSBURGH

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ANNUAL MEETING—ELECTION OF OFFICERS
LIST OF MEMBERS

OFFICIAL PROCEEDINGS
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Organized October 18, 1901

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INDEX—ADVERTISERS.

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PROCEEDINGS OF MEETING

OCTOBER 26, 1933

The Annual Meeting of the Railway Club of Pittsburgh was called to order at the Fort Pitt Hotel at 8 o'clock, P. M., with President F. I. Snyder in the chair.

Attendance as shown by registration cards 459 persons, 22 of which did not sign cards.

MEMBERS

Adams, W. A.
Allderdice, Norman
Ambrose, W. F.
Ament, F. C.
Anger, C. E.
Anger, J. G.
Ashley, F. B.
Babcock, F. H.
Barr, H. C.
Beam, E. J.
Bell, Dan H.
Berg, Karl
Berghane, A. L.
Best, D. A.
Blest, M. C.
Bonhoff, E. L.
Bowden, T. C.
Braun, O. F.
Britt, T. E.
Buffington, W. P.
Burel, W. C.
Burnette, G. H.
Callahan, F. J.
Campbell, Edward D.
Campbell, J. E.
Cannon, T. E.
Carlson, L. E.
Carr, T. W.
Carran, E. W.
Carruthers, G. R.
Carson, John
Christy, F. X.
Church, S. L.
Clements, Frank C.
Code, J. G.
Conway, J. D.
Coombe, A. B.
Cotter, G. L.
Coulter, A. F.
Courtney, H.
Crawford, A. B.
Crawford, D. F.
Cromwell, H. T.
Cruikshank, J. C.
Cunningham, R. I.
Cunningham, W. P.
Dalzell, W. E.
Dambach, C. O.
Daugherty, W. A.
Davis, Charles S.
Dehne, George C.
Dickinson, T. R.
Down, S. G.
Doyle, Edward
Dunbar, Harold F.
Emery, E.
Emsheimer, Louis
Endsley, Prof. Louis E.
Falkner, A. J.
Farmer, C. C.
Farrington, R. J.
Fenton, H. H.
Fink, P. J.
Fischer, G. E.
Fisher, J. J.
Fleckenstein, August
Flinn, R. H.
Forsberg, R. P.
Fox, George W.
Frauenheim, P. H.
Freshwater, F. H.
Fritz, A. A.
Gaffney, Thomas H.
Gardner, George R.
Gellatly, W. R.
Germak, George A., Jr.
Gilg, Henry F.
Gillespie, J. Porter

Glaser, J. P.
Gleeson, H. L.
Glenn, J. H.
Grieve, Robert E.
Guinnip, M. S.
Hackett, C. M.
Haller, Nelson M.
Hancock, Milton L.
Hansen, William C.
Harbaugh, Charles P.
Harman, H. H.
Harper, G. C.
Harper, J. T.
Hayward, Carlton
Hepburn, P. W.
Hilstrom, A. V.
Holmes, E. H.
Honsberger, G. W.
Hoover, J. W.
Huff, A. B.
Hughes, I. Lamont
Hughes, John E.
Hursh, S. R.
Hykes, W. H.
Irwin, R. D.
Johnson, William M.
Johnston, Harvey F.
Jones, L. E.
Jones, William M.
Kapp, A. C.
Kaup, H. E.
Keller, R. B.
Keller, R. E.
Kentlein, John
Kerr, C. R.
Kirk, W. B.
Klassen, F. G.
Kroske, J. F.
Kruse, J. F. W.
Kummer, J. H.
Lanahan, Frank J.
Lanahan, Jas. Stevenson
Layng, F. R.
Lees, Thomas
Long, R. M.
Longdon, Clyde V.
Lynn, Samuel
Lynn, William
Maliphant, C. W.
Masterman, T. W.
Merscher, John
Millar, C. W.
Miller, John
Mills, C. C.
Misner, George W.
Mitchell, W. S.
Moir, W. B.
Montague, C. F.
Montgomery, J. L.
Moore, D. O.
Moyer, O. G. A.
Muir, R. Y.
Murray, Stewart
Myers, Arnold
McCrea, James G.
McFetridge, W. S.
McHugh, C. A.
McIntyre, R. C.
McKinley, John T.
McMillan, A. P.
McPherson, A. R.
Nagel, James
Nieman, H. L.
O'Connor, M. J.
O'Leary, Jeremiah J.
Orbin, G. N.
Orbin, Joseph N.
Orchard, Charles
O'Sullivan, J. J.
O'Toole, J. L.
Paisley, F. R.
Pickard, S. B.
Pillar, Michael
Pollock, J. H.
Posteraro, S. F.
Pringle, Paul V.
Pugh, A. J.
Purchard, Paul
Ralston, John A.
Rauschart, E. A.
Record, J. Fred
Redding, P. E.
Redding, R. D.
Renshaw, W. V.
Reuter, Paul C.
Richardson, E. F.
Rizzo, C. M.
Robinson, R. L.
Rowles, H. N.
Rutter, Harley E.
Ryan, Frank J.
Schaffer, W. E.

Schaller, A. J.
Schrader, A. P.
Searles, E. J.
Seiss, W. C.
Sekera, C. J.
Severn, A. B.
Sheets, H. E.
Sheridan, T. F.
Simons, Philip
Smith, Charles F.
Smith, J. Frank
Snyder, F. I.
Snyder, J. C.
Stearns, William G.
Stephen, James
Stevens, L. V.
Stillwagon, C. K.
Stoffregen, Louis E.
Stucki, A.
Sullivan, P. W.
Swope, B. M.
Sykes, Arthur H.
Thomas, Raymond E.
Trautman, H. J.
Trax, L. R.
Triem, W. R.
Van Vranken, S. E.
Walther, G. C.
Wark, J. M.
Waterman, E. H.
Watt, Herbert J.
Weaver, W. Frank
Webster, H. D.
Whalen, D. J.
Wheeler, C. M.
Wildin, G. W.
Winslow, G. W.
Woodward, R.
Wright, John B.
Yarnall, Jesse

VISITORS

Acton, J. C.
Allman, C. T.
Alston, Arch, Jr.
Anderson, W. G.
Bacon, J. C.
Baker, George N.
Barnes, Dr. Braden
Beam, W. H.
Beck, Joseph
Bell, B. P.
Berger, John S.
Bergman, Oscar
Beswick, R. W.
Betts, S. P.
Bishop, M. L.
Bitzel, Harry J.
Blondel, J. H.
Boal, Charles A.
Bockert, C. G.
Bollinger, William A.
Bott, W. J.
Boyer, W. W.
Brown, R. J.
Brumbaugh, J. B.
Bryant, L. J.
Buerkle, E. C.
Buffington, W. P., Jr.
Burgess, T. S.
Burgess, W. C.
Burkhard, John J.
Burns, Robert C.
Burriss, H. E.
Burriss, Walter C.
Cable, T. H.
Campbell, W. M.
Carver, C. T.
Christy, George J.
Cisp, George
Clark, John M.
Colclaser, L. A.
Connors, P. M.
Cooley, G. B.
Couch, N. B.
Craig, James A.
Cravener, J. H.
Critchlow, C. L.
Cubra, Michael
Dambach, W. E.
Davis, William B.
Dempsey, A.
Downing, W. T.
Doyle, W. E.
Driscoll, F. X.
Duerr, William
Dunkirk, J. J.
Dunsmoor, F. L.

Dzugan, John
Dzugan, John, Jr.
Eichhorn, T. F.
Evans, C. V.
Evans, W. H.
Faison, L. H.
Farrington, Arthur R.
Farrington, Robert J.
Faust, C. R.
Ferguson, Donald S.
Fields, D. S.
Fink, Albert J.
Forger, F. J.
Forrester, J. B.
Franks, William
Friend, Edward F.
Friend, R. A.
Galba, Fred
Germak, John
Gill, A. H.
Goodwin, A. E.
Gower, Robert
Gray, R. H.
Grieve, Carl H.
Grimm, W. R.
Haggerty, J. F.
Hahn, H. A.
Hamilton, J. S.
Hammond, C. W.
Hartmeyer, T. H.
Hedges, A. H.
Heinsberg, A. H.
Henk, G. J.
Henry, John
Hockenberry, H. D.
Hodgson, John
Homer, Luther F.
Hawthorne, J.
Hoerner, A. S.
Holt, James
Hunter, D. C.
Janis, G. L.
Jenkins, R. H.
Jennings, Emil
Johnson, David
Johnson, Henry D., Jr.
Juski, John
Kester, M. B.
Keys, A. H.
Kirchner, H. B.
Kistler, T. E.
Kohl, C. G.
Kraft, R. A.
Krause, A. J.
Kurtz, John C.
Larson, W. E.
Latshaw, T. R.
Laux, W. L.
Laux, W. L., Jr.
Leech, George R.
Leonard, Ross C.
Letzkus, L. C.
Lewis, Ralph S.
Lewis, S. B.
Lincoln, J. J.
Lind, F. J.
Macoubray, R. J.
Maloney, J.
Maple, Thomas S.
Marsh, Earl H.
Marsh, Ernest W.
Mayer, L. I.
Magee, C. R.
Meier, W. F.
Metzger, Christian L.
Millard, J. H.
Miller, Bernard B.
Miller, Fred J.
Miller, George
Miller, H. L.
Miller, R. E.
Miller, Theodore P.
Mitchel, A.
Moeller, Frank J.
Moles, Frank B.
Moles, William G.
Montgomery, W. E.
Moore, D. M.
Morse, F. L.
Musgrove, W. W.
Mycoff, George H.
McConn, G. E.
Neely, Harold D.
O'Hagan, J. E.
O'Laughlin, M. J.
Oldham, R. W.
Palahunich, George
Phlegan, A. B.
Pillar, John
Plank, L. G.
Pollitt, R. R.
Potter, A. C.

Prosser, David
Pyreux, L.
Rach, R. C.
Rauschart, Frederick
Rauschart, R.
Reardon, Frank J.
Riggs, W. F.
Robertson, T. H.
Roughen, R. H.
Rowley, C. R.
Ruch, Paul R.
Ryan, D. M.
Schadt, Alton D.
Schott, F. J.
Schrontz, S. B.
Schuch, H. C.
Seigh, Wallace I.
Sellinger, Howard H.
Severn, Harry A.
Sheldon, Fred B.
Sheparson, F. C.
Shoemaker, G. C.
Shropshire, Paul
Singer, William
Smith, Sion B.
Smith, William
Snyder, George S.
Snyder, H. C.
Spratt, John
Stearns, Carl
Steimer, L. S.
Stevens, A. R.
Stevenson, L. N.
Strong, George
Studen, John
Talbot, R. A.
Thomas, George P.
Tomlinson, Charles H.
Trkulja, P. M.
Turner, W. J.
Tutoky, John
Vandivort, R. E.
Van Winkle, Paul
Vogel, E. E.
Walton, H. R.
Ward, H. N.
Ward, H. C.
Warrensford, Fred S.
Weitzel, A. G.
Westerman, F. R.
Wheatley, Albert R.
Wheatley, Charles
Williams, A. G.
Wilson, George F.
Winkler, A. H.
Wolf, Joseph
Wood, H. N.
Zec, Michael
Zec, Paul

PRESIDENT: This is the Annual Meeting of the Club and we have a special order of business to go through. We will proceed with that as rapidly as possible to get to the entertainment of the evening.

We will dispense with the roll call and the reading of the minutes unless there is objection. The current issue of the Proceedings has been delayed a little owing to difficulty in getting certain cuts necessary to illustrate the paper, but they will be mailed very shortly.

The next order of business is the receiving of proposals for membership.

SECRETARY: We have the following proposals for membership:

Bancroft, A. G., Vice President, Union Metal Products Company, New Kensington, Pa. Recommended by John A. Ralston.

Kilborn, W. T., Vice President, Flannery Bolt Company, Bridgeville, Pa. Recommended by E. S. Fitz Simmons.

Ogden, F. A., Jr., Railway Sales and Traffic, Pittsburgh Steel Foundry Corporation, 27 Kingston Avenue, Crafton, Pa. Recommended by Lloyd Sutherland.

Pinkerton, C. J., Industrial Sales Manager, The Watson Standard Company, 225 Galveston Avenue, North Side, Pittsburgh, Pa. Recommended by A. E. Herrold.

Reymer, C. H., Special Representative, Oliver Iron & Steel Corporation, South Tenth and Muriel Streets, Pittsburgh, Pa. Recommended by Joseph N. Orbin.

Schadt, Alton D., Clerk, Office V. P. & G. M., Bessemer & Lake Erie Railroad, 7338 Whipple Street, Pittsburgh (18), Pa. Recommended by F. I. Snyder.

PRESIDENT: These proposals will be referred to the Executive Committee, in accordance with our By-laws, and upon approval by that Committee the gentlemen will become members without further action of the Club. Are there any announcements?

SECRETARY: Since our last meeting we have received information of the death of the following members:

R. H. Anthony, Freight Claim Agent, P. & L. E. R. R., Pittsburgh, Pa., died July 28, 1933, and O. H. Hubacher, Locomotive Engineer, P. & L. E. R. R., McKees Rocks, Pa., died March 4, 1933.

PRESIDENT: An appropriate memorial minute will appear in the next issue of the Proceedings.

We are now ready to receive the annual reports of the various officers.

First will be the Report of the Secretary.

SECRETARY'S REPORT

Pittsburgh, Pa., October 26, 1933.

To the Officers and Members of
The Railway Club of Pittsburgh.

Gentlemen:

The following is a summary of membership and financial statement for the fiscal year ended October 26, 1933:

Membership reported last year	949	
Received into membership during year	65	
		1,014

Suspended non-payment dues	78	
Resigned	50	
Loss of address	5	
Deaths reported during year	12	
	—	145
Present membership		869

Of the above membership four are honorary. They are: D. C. Buell, D. F. Crawford, Samuel O. Dunn and John A. Penton.

DECEASED MEMBERS

Name	Died
R. H. Anthony	July 28, 1933
James H. Champion	April 17, 1931
W. F. Deneke	August 20, 1933
O. H. Hubacher	March 4, 1933
Elisha Lee	August 6, 1933
P. L. Lobez	November 16, 1932
I. H. Milliken	December 30, 1932
J. B. Reed	December 14, 1932
Ralph H. Tate	May 5, 1933
Sir Henry W. Thornton	March 14, 1933
A. B. White	April 19, 1933
J. B. Yohe	December 18, 1932

FINANCIAL

RECEIPTS

In hands of Treasurer at close of last year	$6,056.89	
From advertisements	674.70	
From dues	1,881.00	
From sale of Proceedings	7.50	
Smoker Tickets and Dinner, October 27, 1932	369.75	
Miscellaneous sources	32.20	
Profit on sale of one $1,000.00 3⅛% U. S. Treasury Bond	53.52	
Interest from U. S. Treasury and Liberty Bonds and bank balance	191.31	
		$9,266.87

DISBURSEMENTS

Printing Proceedings, notices, mailing, etc	$1,730.60
Hall, luncheons, cigars, etc	768.85
Reporting Proceedings	180.00

Dinner, Entertainment, Smoker, etc., October 27, 1932	500.15	
Salaries and advertising expense	1,067.47	
Moving pictures	53.50	
Messenger service, affidavits, etc.	18.75	
Premium on Bonds—Treasurer and Secretary	10.00	
Incidentals	34.62	
Keystone Bank balance	50.00	
Federal tax on checks paid	.58	
		$4,414.52
Net Balance		$4,852.35

Balance is made up of $953.56 cash and two U. S. $1,000.00 4¼% Liberty Bonds and two $1,000.00 3⅛% U. S. Treasury Bonds at cost of $1,898.79.

J. D. CONWAY, Secretary.

APPROVED:

EXECUTIVE COMMITTEE,
FRANK J. LANAHAN, Chairman.

PRESIDENT: What is your pleasure? The Report has received the approval of the Executive Committee. Is there any discussion of it?

ON MOTION the Report is adopted.

PRESIDENT: We will now have the Report of the Treasurer.

The Treasurer's Report was read by the Secretary, as follows:

TREASURER'S REPORT

To the Officers and Members of
The Railway Club of Pittsburgh.

Gentlemen:

I herewith submit my report for the year ended October 26, 1933:

ON HAND AND RECEIPTS

Cash on hand, October 27, 1932	$1,208.71
Moneys received from J. D. Conway, Secretary, from October 28, 1932, to October 26, 1933	2,915.15
Interest at 4¼% on two $1,000.00 par value Liberty Bonds	85.00
Interest at 3⅛% on three $1,000.00 par value U. S. Treasury Bonds	93.75

Interest on bank balance, December 31, 1932	12.56	
Proceeds from sale of one $1,000.00 U. S. Treasury Bond	1,002.91	
Total Receipts		$5,318.08

DISBURSEMENTS

Paid on Vouchers 774 to 802, inclusive	$4,363.94	
Federal tax on 29 checks at 2 cents each	.58	
Total Disbursements		$4,364.52
Balance		953.56

RESOURCES

Two U. S. Liberty Bonds at $1,000.00 each	$2,000.00	
Two U. S. Treasury Bonds at purchase price	1,898.79	
Cash balance	953.56	
Total Resources		$4,852.35

In order to provide cash for defraying current expenses it was found necessary to sell one of your 3⅛% U. S. Treasury Bonds.

This transaction was completed on July 5, 1933, at a price of $1,002.91, and inasmuch as the purchase price of this bond was $949.39 there was a net profit from the sale of $53.52.

E. J. SEARLES, Treasurer.

APPROVED:

EXECUTIVE COMMITTEE,
FRANK J. LANAHAN, Chairman.

PRESIDENT: What is your pleasure with respect to the Treasurer's Report?

ON MOTION the Report is adopted.

We have audited the accounts of the Secretary and Treasurer, and find them correct as reported.

FINANCE COMMITTEE,
CHARLES ORCHARD, Chairman,
JOHN B. WRIGHT,
J. S. LANAHAN,
F. X. CHRISTY.

PRESIDENT: Next in order is the Report of the Tellers of Election. I will ask the Secretary to read the Report.

SECRETARY: The result of the election is as follows:

Total number of votes cast 189, and the vote in each case unanimous for the gentlemen named.

PRESIDENT—C. O. Dambach, General Manager, Pittsburgh & West Virginia Railway Company, Pittsburgh, Pa.

FIRST VICE-PRESIDENT—R. H. Flinn, General Superintendent, Pennsylvania Railroad, Pittsburgh, Pa.

SECOND VICE-PRESIDENT—Curtis M. Yohe, Vice-President, Pittsburgh & Lake Erie Railroad Company, Pittsburgh, Pa.

SECRETARY—J. D. Conway.

TREASURER—E. J. Searles, Manager, Schaefer Equipment Company, Pittsburgh, Pa.

EXECUTIVE COMMITTEE—Frank J. Lanahan, Chairman; A. Stucki, Samuel Lynn, D. F. Crawford, G. W. Wildin, W. S. McAbee, E. W. Smith, Louis E. Endsley, John E. Hughes, F. I. Snyder.

SUBJECT COMMITTEE*—R. P. Forsberg, Chairman, 1 year; D. W. McGeorge, 2 years; John B. Wright, 3 years.

RECEPTION COMMITTEE*—T. E. Cannon, Chairman; Karl Berg, 1 year; G. M. Sixsmith, H. E. Graham, 2 years; J. B. Baker, Walter C. Sanders, G. A. Blackmore, J. S. Lanahan, 3 years.

ENTERTAINMENT COMMITTEE*—Jacob W. Hoover, Chairman, 1 year; James R. Geddes, 3 years.

FINANCE COMMITTEE*—E. A. Rauschart, Chairman, 3 years; F. X. Christy, E. Emery, Harold F. Dunbar, 2 years; J. L. O'Toole, 3 years.

MEMBERSHIP COMMITTEE*—F. J. Nannah, Chairman; T. Fitzgerald, A. M. Frauenheim, H. T. Cromwell, 1 year; Herbert J. Watt, T. F. Sheridan, Donald O. Moore, 2 years; A. B. Severn, W. P. Buffington, Joseph H. Kummer, 3 years.

PRESIDENT: These gentlemen whom you have elected to carry on the affairs of your Club for the coming year are

*In addition to newly elected committee members, the above list also gives names of those previously elected whose terms of office have not yet expired.

all very well known to you. In a moment I would like to have them make themselves visible to you, but first I would like to say to them that they are succeeding to a fine heritage—and I say that without any personal connection because it is due to the enthusiasm and loyalty that the membership has always given to those who have served in office. I am sure these new officers will give you a very fine administration.

We are going through pretty difficult times. As you have noticed from the Secretary's Annual Report, we have a smaller membership than we had a year ago, and this for reasons that we pretty largely cannot control. We do want to say to those who have found it necessary to drop out temporarily, as soon as you can possibly do so we hope you will restore yourselves to good standing, because we need you and we miss you. Meanwhile you will be welcome at all the meetings of the Club.

The President-elect, Mr. C. O. Dambach, is known to most of you as Charlie, and to a few of you as Ott. Ott, won't you come up here and tell us something?

MR. C. O. DAMBACH: Mr. President and Fellow Members: Since joining this Club about thirty years ago, the regularity with which I have attended its meetings should indicate more forcibly than any words of mine the respect and admiration I hold for this association. In view of that you will readily understand why I welcome this opportunity to thank you in appreciation of the honor you have bestowed upon me.

As our President has stated, we have been passing through a depression. A great many Clubs similar to ours have temporarily discontinued their activities. Notwithstanding this the Railway Club of Pittsburgh has had one of the most satisfactory years in its history. The entertainment has been unusually good, due in large measure to the personal efforts of our retiring President, and the papers have been both interesting and instructive. And it is my fond hope that with the assistance of the able Committees, the enthusiastic co-operation of all our members, and the thought that we are past the depression, the coming year will be as successful as the one now drawing to a close. I thank you.

PRESIDENT: The First Vice-President-elect is Mr. Rufus H. Flinn of the Pennsylvania Railroad. May we hear from you, Rufus?

MR. R. H. FLINN: Mr. Ex-President and fellow Mem-

bers: I did not think I would be called upon to make a speech just at this particular juncture. There isn't anything very much that I could say after Mr. Dambach's eloquent remarks, but I do wish to assure you that I appreciate the honor of being elected Vice-President of this wonderful Club and I will do my very best to serve the Club in every way I can during the ensuing year. I thank you very much and I shall enjoy my work with you.

PRESIDENT: The Second Vice-President-elect is Mr. Curtis M. Yohe. Is he present?

MR. FRANK J. LANAHAN: Mr. Yohe is not here and I would suggest that Mr. O'Toole might represent him.

PRESIDENT: Mr. O'Toole, may we hear from you?

MR. J. L. O'TOOLE: I am informed that I was to respond for Mr. Yohe, the Second Vice-President-elect. My attention was distracted and I did not get that part of the President's remarks. It would be with considerable hesitancy that I would attempt to speak for my superior officer. But I am sure that were Mr. Yohe here, with his usual urbanity and with a wealth of expression far beyond my humble powers, he would fittingly express his appreciation of the honor you have conferred upon him by this election, and I am certain that he would also express a great pride in the opportunity to follow along the pathway of service to this Club made memorable by the distinguished service of his revered father in the earlier years of the Club's existence. In behalf of the Second Vice-President-elect may I offer his sincere thanks and devotion.

PRESIDENT: We do not often hear from our past-present- and future-Secretary. I am sure we would like to hear from him at this time.

SECRETARY J. D. CONWAY: I have worn out my voice trying to have the Reports reach you in the various parts of this noisy room. However, it is very gratifying indeed to know that you would retain me in office regardless of the results of the last year. Your confidence may be misplaced, for people have been deceived in elections before this. Seriously, I do appreciate the confidence you show in continuing me as your Secretary, for I was the first Secretary of the Club thirty-two years ago. There have been a few gray hairs developed during that time, perhaps from the effort of serving you. Perhaps it

developed more gray hairs for you than for me! I do want to express my deep appreciation of your continued confidence.

PRESIDENT: Continuing the same line of thought, we would like to hear from our past- present- and future-Treasurer, Mr. E. J. Searles.

MR. E. J. SEARLES: I thank you very much for the honor of your re-election as Treasurer and I promise faithful and diligent service.

PRESIDENT: That completes the business of the evening. We have an Entertainment Committee that has been working hard in getting together a fine entertainment for you tonight, and recognizing the qualifications of our genial Secretary for Master of Ceremonies, they have turned that job over to him. I now introduce Mr. Conway, on behalf of the Entertainment Committee, as Master of Ceremonies.

MR. J. D. CONWAY: Your Committee has provided an entertainment which we hope will please you in every respect. Those of you who have been at the Century of Progress Exposition at Chicago or have read about it may recall a feature of their entertainment draped around or in some way mixed up with two fans. We hope you will not be shocked if we bring in a performance that has only one fan. But before we bring in anything in the line of entertainment that might disturb you as that might do, we have with us an old stand by, a wheel horse of this Club that we all know and love and he comes from those wonderful precincts of McKees Rocks that we have heard so much about. He is Chairman of the Executive Committee and he has worked faithfully for many, many years in the interests of this Club, and we could not start the performance tonight without calling on him for a few remarks, Mr. Frank J. Lanahan.

MR. FRANK J. LANAHAN: That is certainly starting out under a handicap! Being one of the Executive Committee, it is in order for me to say something about the Club. Indeed, it would not be proper to neglect the splendid opportunity with such a large and brilliant audience as we have here, of extolling the merits of this wonderful organization of ours.

Comments on the entertainment tonight is superfluous. Your enthusiasm over the various numbers is proof-evident of your enjoyment. This is the social side, but acknowledgment

should be made to the Program Committee for what they have contributed in the way of education and enjoyment for this year. Certainly have the gentlemen in charge of this important function of the Club lived up to the splendid traditions of the organization. The unusual interest that has been manifest and the various discussions that followed, certainly can be taken as a compliment.

Particularly to the Chairman of the Committee, Mr. Forsberg, can we pass enconiums; he did a wonderful job and there is enough honor to be shared by his associates.

In President Snyder's remarks he most punctiliously gave due credit for the functioning of all the officials of the Railway Club, but eliminated himself. To this slip I must take exception; he is entirely too modest. Certain am I that the members will all agree with me, paraphrasing the N.R.A. and interpreting these initials to describe our retiring chief executive, it can be truthfully stated that he is "natural", that he has been "resourceful" and he surely is "able". All of these qualities has he demonstrated during his occupancy of the chair the past year. Long has it been the custom in the Railway Club to manifest appreciation for the faithful services of those who guided the destinies of the organization. Fortunate, indeed, have we been in the type of gentlemen whom we have had as our chief executives. It just seems that there is a constant improvement, that each new administration is a little more efficient than its predecessor, so by that measuring stick, Frank Snyder is in the front rank. Now he becomes a part of the Executive Committee and will share in the selection of the individuals that we count on serving the Club in the years to come with the same capability and satisfaction as has characterized the officers of the past.

The Club can derive comfort from the financial report that has been made by Mr. Conway and the Treasurer. In spite of the depression, we are still solvent, having money in bank and good marketable securities. Though we have lost some members, it is but reasonable to suppose that as soon as these fellows get back to work and the pay envelope is in evidence, those delinquent will take steps to be reinstated and we will be glad to welcome them to our midst. If by chance there is anyone in the audience tonight who is not familiar with our organization, may I make known that the Club is composed of those affiliated with the railroads, not alone in managerial capacities, but also those from every walk in the transportation service.

Thoroughly democratic in its demeanor, also railroad supplymen and any others having an interest in matters pertaining to general transportation are eligible. Once every month during the year do we meet, with the exception of June, July and August. Worthwhile subjects are presented by able authorities and each member is in addition to attending meetings, entitled to the printed "Proceedings" which cover the subject of each meeting in its entirety, including the discussions. Of inestimable value are these little booklets, for you can at your leisure study what has been given by the speakers and keep a file for ready reference. Mention should not be neglected that every evening after the meeting, a lunch is served, where a fellow that is hungry can get an honest-to-goodness meal, and all of these, the meeting, the proceedings and the eats, are included in the paltry sum of Three Dollars a year, which surely is the maximum of return for the minimum of expenditure. If anyone is interested, the Secretary has application blanks he would be glad to furnish, and in turn, after your election, will be glad to welcome you into full membership.

An assignment has been given me as a member of the Executive Committee to take cognizance of the change that takes place tonight in the administrative affairs of the Club. The ability, the courtesy and the constant concern of our retiring President have been dwelt on by others and it would be like "carrying coals to New Castle" to repeat these eulogies. Apparent is it to all who have been here meeting after meeting, the satisfactory manner in which have been conducted the affairs of the organization. You know that with tonight President Snyder is passing along, relinquishing his authority to his successor, but we who have enjoyed his leadership and his genial companionship, are desirous that he have some tangible evidence of both our appreciation and esteem. The token that the Committee has selected as a testimonial to our retiring President is indicative of the affectionate regard in which he is held, and as the medium of presenting this to our good friend, I will ask you, Mr. Conway, to kindly remove the veil that covers this gift so that all in the audience may see what is given with their good wishes.

(There was then unveiled a beautiful mahogany grandfather's clock and a nest of tables, the clock very obligingly sounding the soft Westminster chimes.)

It was the unanimous opinion of the Committee that a clock was a very appropriate thing for a gentleman of the qualities

of the retiring President, especially that particular kind of a clock. In the first place, it is pleasing in appearance, and secondly, it has splendid insides; then it is always on time and no person ever knew of Frank Snyder being a moment late. Again, it ticks ticks low and soft, to make its presence known and the recipient of this token has a well modulated voice and talks just enough to earn the appreciation of his vast circle of friends.

Now, Frank, you can take this clock and nest of tables home with you, surprise your good wife and sort of nonchalantly remark, "This is what the Railway Club gave me tonight", and you can't be blamed for feeling a little chesty over the distinction. There are times in all men's lives when they can be justly proud, and tonight, Mr. Retiring President, you are justified in enjoying this in full measure. It is our unanimous wish that you will get the maximum of pleasure out of this remembrance from us and please be aware it is given to you with our highest regard and affection.

MR. SNYDER: Mr. Lanahan and Fellow Members: This is a moment of pleasure to me and a moment of embarrassment. It is a moment of pleasure because I am associated with a Club such as this and because I have had the honor—and I use the word very sincerely and advisedly—of serving you in the highest position within your gift. It is a moment of embarrassment because I do not know how to express what I feel of gratitude and appreciation. So I will just say "Thank you."

The meeting now belongs to John Conway.

There followed a program of song and entertainment sufficiently varied in character to meet every taste and of such high character as to satisfy every requirement, at the close of which an expression of appreciation was extended to the Committee and to Mr. Conway.

PROGRAM PRESENTED AS FOLLOWS:

Opening program by Maude Ingersoll's Dutch Girls Band, Featuring Lee Hickle at The Drums.

The Two Queens, Dance team. Eileen Dale, Kay Barry.

The Ring Master.

Midget Act, Lavery Sisters in song and dance.

Toe Dance, Eileen Dale.

Song and Dance, Frances Robb.

Clyde Schaffer, Character actor, formerly with George Sharp Players, singing some of his song hits from Ten Nights In A Bar Room.

Trio of dancers, Two Queens and A Jack, Misses Eileen Dale, Kay Frances and Don King.

Closing program by the band.

Following the entertainment a very sumptuous luncheon was served in the main dining room of the hotel.

J. D. CONWAY, Secretary.

CONSTITUTION

ARTICLE I

The name of this organization shall be "THE RAILWAY CLUB OF PITTSBURGH."

ARTICLE II

OBJECTS

The objects of this Club shall be mutual intercourse for the acquirement of knowledge, by reports and discussion, for the improvement of railway operation, construction, maintenance and equipment, and to bring into closer relationship men employed in railway work and kindred interests.

ARTICLE III

MEMBERSHIP

SECTION 1. The membership of this Club shall consist of persons interested in any department of railway service or kindred interests, or persons recommended by the Executive Committee upon the payment of the annual dues for the current year.

SEC. 2. Persons may become honorary members of this Club by a unanimous vote of all members present at any of its regular meetings, and shall be entitled to all the privileges of membership and not be subject to the payment of dues or assessments.

ARTICLE IV

OFFICERS

The officers of this Club shall consist of a President, First Vice President, Second Vice President, Secretary, Treasurer, Finance Committee consisting of five or more members, Membership Committee consisting of seven or more members, Entertainment Committee consisting of three members, Reception Committee consisting of six or more members, Subject Committee consisting of three or more members, and an Elective Executive Committee of three or more members. The officers named shall serve a term of one year from date of their election, with the exception of the Finance, Membership, Entertainment, Reception and Subject Committees; the term of office of these committees shall be specified at the time of the Annual Election, but the term of office of the members of such committees shall not exceed three years.

ARTICLE V

DUTIES OF OFFICERS

SECTION 1. The President shall preside at all regular or special meetings of the Club and perform all duties pertaining to a presiding officer; also serve as a member of the Executive Committee.

SEC. 2. The First Vice President, in the absence of the President, will perform all the duties of that officer; the Second Vice President, in the absence of the President and First Vice President, will perform the duties of the presiding officer. The First and Second Vice President shall also serve as members of the Executive Board.

SEC. 3. The Secretary will attend all meetings of the Club or Executive Committee, keep full minutes of their proceedings, preserve the records and documents of the Club, accept and turn over all moneys received to the Treasurer at least once a month, draw checques for all bills presented when approved by a majority of the Executive Committee present at any meetings of the Club, or Executive Committee meeting. He shall have charge of the publication of the Club Proceedings and perform other routine work pertaining to the business affairs of the Club under the direction of the Executive Committee.

SEC. 4. The Treasurer shall receipt for all moneys received from the Secretary, and deposit the same in the name of the Club within thirty days in a bank approved by the Executive Committee. All disbursements of the funds of the Club shall be by checque signed by the Secretary and Treasurer.

SEC. 5. The Executive Committee will exercise a general supervision over the affairs of the Club and authorize all expenditures of its funds. The elective members of this Committee shall also perform the duties of an auditing committee to audit the accounts of the Club at the close of a term or at any time necessary to do so.

SEC. 6. The Finance Committee will have general supervision over the finances of the Club, and perform such duties as may be assigned them by the President or First and Second Vice Presidents.

SEC. 7. The Membership Committee will perform such duties as may be assigned them by the President or First and Second Vice Presidents and such other duties as may be proper for such a committee.

SEC. 8. The Entertainment Committee will perform such duties as may be assigned them by the President or First and Second Vice Presidents, and such other duties as may be proper for such a committee.

ARTICLE VI

ELECTION OF OFFICERS

SECTION 1. The officers shall be elected at the regular annual meeting as follows, except as otherwise provided for:

SEC. 2. Printed forms will be mailed to all the members of the Club, not less than twenty days previous to the annual meeting, by the elective members of the Executive Committee. These forms shall provide a method, so that each member may express his choice for the several offices to be filled.

SEC. 3. The elective members of the Executive Committee will present to the President the names of the members receiving the highest number of votes for each office, together with the number of votes received.

SEC. 4. The President will announce the result of the ballot and declare the election.

SEC. 5. Should two or more members receive the same number of votes, it shall be decided by a vote of the members present, by ballot.

ARTICLE VII

AMENDMENTS

Amendments may be made to this Constitution by written request of ten members, presented at a regular meeting and decided by a two-thirds vote of the members present at the next regular meeting.

BY-LAWS

ARTICLE I

MEETINGS

SECTION 1. The regular meetings of the Club shall be held at Pittsburgh, Pa., on the fourth Thursday of each month, except June, July and August, at 8 o'clock P. M.

SEC. 2. The annual meeting shall be held on the fourth Thursday of October each year.

SEC. 3. The President may, at such times as he deems expedient, or upon request of a quorum, call special meetings.

ARTICLE II

QUORUM

At any regular or special meeting nine members shall constitute a quorum.

ARTICLE III

DUES

SECTION 1. The annual dues of members shall be Two Dollars, payable in advance on or before the fourth Thursday of September each year.

SEC. 2. The annual subscription to the printed Proceedings of the Club shall be at the published price of One Dollar. Each member of the Club shall pay for both dues and subscription. Dues and subscription paid by members proposed at the meetings in September or October shall be credited for the following fiscal year.

SEC. 3. At the annual meeting members whose dues and subscription are unpaid shall be dropped from the roll after due notice mailed them at least thirty days previous.

SEC. 4. Members suspended for non-payment of dues shall not be reinstated until all arrearages have been paid.

ARTICLE IV

ORDER OF BUSINESS

1—Roll call.
2—Reading of the minutes.
3—Announcements of new members.
4—Reports of Committees.
5—Communications, notices, etc.
6—Unfinished business.
7—New business.
8—Recess.
9—Discussion of subjects presented at previous meeting.
10—Appointment of committees.
11—Election of officers.
12—Announcements.
13—Financial reports or statements.
14—Adjournment.

ARTICLE V

SUBJECTS—PUBLICATIONS

SECTION 1. The Subject Committee will provide the papers or matter for discussion at each regular meeting.

SEC. 2. The Proceedings or such portion as the Executive Committee may approve shall be published (standard size, 6x9 inches) and mailed to the members of the Club or other similar clubs with which exchange is made.

ARTICLE VI

The stenographic report of the meetings will be confined to resolutions, motions and discussions of papers unless otherwise directed by the presiding officer.

ARTICLE VII

AMENDMENTS

These By-Laws may be amended by written request of ten members, presented at a regular meeting, and a two-thirds vote of the members present at the next meeting.

In Memoriam

R. H. ANTHONY

Joined Club March 25, 1926

Died July 28, 1933

O. H. HUBACHER

Joined Club February 25, 1932

Died March 4, 1933

MEMBERS

Aaron, Paul S.,
Fort Pitt Mall. Iron Co.,
304 Grove St.,
McKees Rocks, Pa.

Adams, Walter A.,
Clerk,
P. & L. E. R. R.,
230 Ohio Ave.,
Glassport, Pa.

Adler, Abe C.,
Clerk,
Union Railroad Co.,
Linden Ave.,
East Pittsburgh, Pa.

Allan, W. J.,
Treasurer, Commissary
Co. of America,
1665 New Haven Ave.,
South Hills Branch,
Pittsburgh, Pa.

Allderdice, Norman,
President,
Auto-Tite Joints Co.,
1001 Park Bldg.,
Pittsburgh, Pa.

Allen, Harvey,
Mechanical Engineer,
347 Columbia Ave.,
West View,
Pittsburgh, Pa.

Allinger, Neil J.,
Asst. Supervisor,
Pennsylvania Railroad,
523 West 2nd St.,
Delphos, Ohio.

Allison, John,
Sales Engineer,
Pgh. Steel Foundry Corp.,
Glassport, Pa.

Altsman, W. H.,
Mechanical Engineer,
Harmony Railways,
67 Watsonia Blvd.,
N. S., Pittsburgh, Pa.

Ambrose, W. F.,
M. M., Aliquippa & So. R. R.,
1301 Meadow St.,
Aliquippa, Pa.

Ament, Chalmer F.,
Train Service Inspector,
Pgh. Div., Penna. R. R.,
6932 Standish St.,
Pittsburgh (6) Pa.

Anderson, Burt T.,
Asst. to President,
Union Switch & Signal Co.,
Swissvale, Pa.

Anderson, G. S.,
Foreman,
Penna. System,
Box 19, Penna. Station,
Pittsburgh, Pa.

Anger, C. E.,
Upholsterer Foreman,
P. & L. E. R. R.,
15 Richey Ave.,
N. S., Pittsburgh, Pa.

Anger, John G.,
General Foreman,
P. & L. E. R. R.,
Fifth Ave.,
Coraopolis, Pa.

Anne, George E.,
Representative,
American Brake Shoe &
Foundry Co.,
Apartment 7,
2215 Broad Ave.,
Altoona, Pa.

Arensberg, F. L.,
President,
Vesuvius Crucible Co.,
Box 29,
Swissvale, Pa.

Arnold, J. J.,
Sales Dept.,
Pressed Steel Car Co.,
1915 Farmers Bank Bldg.,
Pittsburgh, Pa.

Ashley, F. B.,
Vice President,
Pruett Schaffer Chemical Co.,
Tabor St.,
Corliss Station,
Pittsburgh, Pa.

Ashton, Wm. A.,
Die Foreman,
Schoen Works,
Carnegie Steel Co.,
1031 Tyndall St.,
Corliss Station,
Pittsburgh, Pa.

Askin, James A.,
Purchasing Agent,
Fort Pitt Malleable Iron Co.,
438 Russellwood Ave.,
McKees Rocks, Pa.

Atterbury, Gen'l. W. W.,
President, P. R. R. Co.,
1617 Pennsylvania Blvd.,
Philadelphia, Pa.

Aulbach, A. J.,
Yardmaster, P. & L. E. R. R.,
318 Quincy Ave.,
Mt. Oliver Sta.,
Pittsburgh, Pa.

Babcock, F. H.,
Safety Agent,
P. & L. E. R. R.,
221 Magnolia Ave.,
Mt. Lebanon,
Pittsburgh, Pa

Bachner, Martin G.,
P. W. I.—P. & L. E. R. R.,
1109 Church Ave.,
McKees Rocks, Pa.

Baer, Harry L.,
Pres., Water Treatment Co.
of America,
2716 Grant Bldg.,
Pittsburgh, Pa.

Bailey, F. G.,
Mechanical Engineer,
Standard Steel Car Corp.,
P. O. Box 839,
Butler, Pa.

Bailey, J. C.,
Car Service Agent,
B. & L. E. R. R.,
350 Main St.,
Greenville, Pa.

Baily, J. H.,
Vice President,
Edgewater Steel Co.,
P. O. Box 249,
Pittsburgh, Pa.

Bair, J. K.,
Locomotive Engineer,
Union Railroad,
139 Brown Ave.,
Turtle Creek, Pa.

Baker, J. B.,
Chief Engr., M. of W.,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Bakewell, Donald C.,
Vice President,
Continental Roll & Steel
Foundry Co.,
2105 Grant Bldg.,
Pittsburgh, Pa.

Balbaugh, John G.,
Sales Engineer,
Pittsburgh Valve Fdy. &
Const. Co.,
26th St. & A. V. Ry.,
Pittsburgh, Pa.

Ball, Fred M.,
District Manager,
Franklin Ry. Sup. Co., Inc.,
Broad St. Station Bldg.,
Philadelphia, Pa.

Ball, George L.,
Secretary and Treasurer,
Ball Chemical Co.,
230 S. Fairmont Ave.,
Pittsburgh, Pa.

Balzer, C. E.,
Insp'r. of Tests,
P. & L. E. R. R.,
3432 Allendale St.,
Pittsburgh, Pa.

Bancroft, A. G.,
Vice President,
Union Metal Products Co.,
New Kensington, Pa.

Bandi, John E.,
Bill Clerk, P. C. & Y. R. R.,
1115 Criss St.,
Pittsburgh, Pa.

Barclay, J. R.,
Cost Engineer,
P. & L. E. R. R.,
4 Oakwood Road,
Crafton, Pittsburgh, Pa.

Barnett, Geo.,
Salesman,
W. W. Lawrence Co.,
West Carson St.,
Pittsburgh, Pa.

Barney, Harry,
President-Treasurer,
Barney Machinery Co., Inc.,
2410 Koppers Bldg.,
Pittsburgh, Pa.

Barr, H. C.,
Agent, P. & L. E. R. R.,
2800 Brentwood Ave.,
Mt. Oliver,
Pittsburgh, Pa.

Barton, C. B.,
Asst. Gen. Passenger Agent,
Seaboard Air Line Railway,
Union Trust Building,
Pittsburgh, Pa.

Batchelar, E. C.,
Manager, The Motch &
Merryweather Mach'y Co.
1315 Clark Bldg.,
Pittsburgh, Pa.

Beam, E. J.,
Car Builder, Penna. System,
577 Fourth St.,
Pitcairn, Pa.

Beattie, J. A.,
1090 Shady Ave.,
Pittsburgh, Pa.

Beaver, R. C.,
Asst. Mechanical Engineer,
B. & L. E. R. R.,
122 West Main St.,
Greenville, Pa.

Beck, John G.,
Representative,
Travelers Insurance Co.,
1649 Shady Ave.,
Pittsburgh, Pa.

Beeson, H. L.,
Engine House Foreman,
Monongahela Ry. Co.,
207 Riverview Terrace,
West Brownsville, Pa.

Bell, D. H.,
Engineer of Car Design,
Pittsburgh Railways Co.,
435 Sixth Ave.,
Pittsburgh, Pa.

Berg, Karl,
Supt. Motive Power,
P. & L. E. R. R.,
6319 Morrowfield Ave.,
Pittsburgh, Pa.

Berghane, A. L.,
Mechanical Expert,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Bernoulli, W. H.,
Pugh Bros.,
211 House Bldg.,
Pittsburgh, Pa.

Bessolo, A. J.,
Asst. Gen. Traf. Mgr.,
Gulf Refining Co.,
Gulf Building,
Pittsburgh, Pa.

Best, D. A.,
Chief Test Engineer,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Binkley, Frank H.,
Yard Foreman,
Union Railroad,
P. O. Box 262,
Unity, Pa

Bishop, C. L.,
Chief Clerk,
Pittsburgh, Mahoning and Shenango Valley Freight Committee,
606 Chamber of Commerce Bldg.,
Pittsburgh, Pa.

Bittner, George,
Ass't. Engine House Fore.,
Penna. R. R.,
2063 Pittview Ave.,
North Side,
Pittsburgh, Pa.

Blackmore, G. A.,
President & General Mgr.
Union Switch & Signal Co.,
Swissvale, Pa.

Blair, John R.,
Asst. General Mgr. of Sales,
Seamless Tube Div'n.,
Pittsburgh Steel Co.,
Union Trust Bldg.,
Pittsburgh, Pa.

Blest, Minot C.,
Chief Engineer,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Boate, H. S.,
Piece Work Inspector,
P. & L. E. R. R.,
438 Russellwood Ave.,
McKees Rocks, Pa.

Bone, H. L.,
General Mechanical Engr.,
Union Switch & Signal Co.,
1025 Macon Ave.,
Pittsburgh, Pa.

Bonhoff, E. L.,
Engine House Fore.,
Penna. Railroad,
718 Blackburn Road,
Sewickley, Pa.

Borg, John Edw.,
Chief Draftsman,
Julian Kennedy,
232 Martsolf Ave.,
West View, Pa

Bottomly, E. S.,
Chief Joint Inspector,
P. R. R., B. & O.,
Rdg. and W. M.,
Martinsburg, W. Va.

Bourke, John P.,
Vice President,
Ewald Iron Co.,
501 Fifth Ave.,
New York, N. Y.

Bowden, Foster S.,
Asst. Supervisor,
Pennsylvania Railroad,
132 South Uhrich St.,
Urichsville, Ohio.

Bowden, T. C.,
Coal Inspector,
B. & L. E. R. R.,
97 S. Mercer St.,
Greenville, Pa.

Bowery, Frank J.,
Chief Estimator, F. C. D.,
P. S. C. Co.,
214 Birmingham Ave.,
Avalon, Pa.

Boylan, P. F.,
Expediter,
Pressed Steel Car Co.,
1314 Orchlee St.,
N. S., Pittsburgh, Pa.

Braden, Lou,
3085 Texas Ave.,
Dormont,
Pittsburgh, Pa.

Bradley, W. C.,
C. C. to Gen'l. Supt.,
Union R. R.,
1808 Lafayette St.,
Swissvale, Pa.

Brady, T. Jos.,
President,
T. J. Brady Co.,
303 Kearsage St.,
Mt. Washington Sta.,
Pittsburgh, Pa.

Brant, Wm. J.,
1001 Bessemer Bldg.,
Pittsburgh, Pa.

Braun, Otto F.,
Gen. Mach. Shop Foreman,
P. & L. E. R. R.,
R. D. 1—Herbst Road,
Coraopolis, Pa.

Brendlinger, M. T.,
Gang Foreman,
Penna. R. R. System,
444 Third St.,
Pitcairn, Pa.

Brennan, John T.,
Vice President,
Greenville Steel Car Co.,
Greenville, Pa.

Brewer, H. W.,
Supt. of Shops,
B. & O. R. R. Co.,
Du Bois, Pa.

Brice, A. E.,
Special Representative,
Gulf Refining Co.,
Gulf Building,
Pittsburgh, Pa.

Britt, T. E.,
Division Storekeeper,
B. & O. R. R.,
2319 Walton Ave.,
Overbrook,
Pittsburgh, Pa.

Brown, C. C.,
Rep., Dearborn Chemical Co.,
618 Farmers Bank Bldg.,
Pittsburgh, Pa.

Brown, Charles L.,
Foreman, R. R. Dept.,
Westinghouse Airbrake Co.,
1206 Greensburg Ave.,
Wilmerding, Pa.

Brown, E. C.,
Chief Civil Engineer,
Carnegie Steel Co.,
Room 1106,
Carnegie Building,
Pittsburgh, Pa.

Brown, E. L.,
Asst. Supervisor, Track,
Pennsylvania Railroad,
6732 Frankstown Ave.,
Pittsburgh, Pa.

Brown, F. M.,
Supt., P. & L. E. R. R.,
Pittsburgh, Pa.

Brown, J. Alexander,
424 W. 33rd St.,
Eleventh Floor,
New York, N. Y.

Brown, John T., Jr.,
Supt., Federated Metal Corp.,
6667 Woodwell St.,
Pittsburgh, Pa.

Browne, Bard,
Asst. to Vice President,
The Superheater Co.,
60 East 42nd St.,
New York, N. Y.

Bruce, S. S.,
General Traffic Manager,
The Koppers Co.,
Koppers Bldg.,
Pittsburgh, Pa.

Buckbee, W. A.,
The Superheater Co.,
Nyack, N. Y.

Buckwalter, T. V.,
Vice President,
Timken Roller Bearing Co.,
Canton, Ohio.

Buell, D. C.,
Director, The Railway Educational Bureau,
1809 Capitol Ave.,
Omaha, Neb.

Buffington, W. P.,
Traffic Mgr.,
Pittsburgh Coal Co.,
P. O. Box 64,
Pittsburgh, Pa.

Bull, R. S.,
Supt. Power & Inclines,
Pittsburgh Railways Co.,
600 Sandusky St.,
N. S., Pittsburgh, Pa.

Burel, W. C.,
Master Mechanic,
Western Allegheny R. R.,
Kaylor, Pa.

Burgham, Maurice L.,
Sales Department,
Edgewater Steel Co.,
P. O. Box 249,
Pittsburgh, Pa.

Burnette, G. H.,
Asst. Chief Engineer,
P. & L. E. R. R.,
Terminal Building,
Pittsburgh, Pa.

Butler, R. E.,
Vice President,
Rust Engineering Co.,
Koppers Bldg.,
Pittsburgh, Pa.

Byers, Thomas,
General Agent
Delaware & Hudson R. R.,
Koppers Bldg.,
Pittsburgh, Pa.

Byrne, William L.,
Sales Engineer,
Royal Railway Supply Co.,
House Bldg.,
Pittsburgh, Pa.

Cady, P. C.,
Railway Supplies,
30 Church St., Room 506,
New York City.

Caldwell, C. W.,
Rep., James B. Sipe & Co.,
Chamber of Commerce Bldg.,
Pittsburgh, Pa.

Callahan, F. J.,
Gang Leader,
Montour Railroad,
1109 Chartiers Ave.,
McKees Rocks, Pa.

Callahan, Lawrence H.,
Yardmaster, P. & L. E. R.,
600 Monongahela Ave.,
McKeesport, Pa.

Campbell, Edward D.,
Traffic Manager,
B. & L. E. R. R.,
P. O. Box 456,
Pittsburgh, Pa

Campbell, James E.,
Agent, P. & L. E. R. R.,
512 Twelfth Avenue,
Munhall, Pa.

Cannon, J.,
Vice Pres. & Gen. Mgr.,
Missouri Pacific R. R. Co.,
Missouri Pacific Bldg.,
St. Louis, Mo.

Cannon, T. E.,
Gen. Supt., Motive Power &
Equipment,
P. & W. Va. Ry.,
Wabash Bldg.,
Pittsburgh, Pa.

Cardwell, J. R.,
President,
Cardwell Westinghouse Co.
332 S. Michigan Ave.,
Chicago, Ill.

Carlson, Frank R.,
Sales Dept., Chicago Rwy.,
Equipment Co.,
1907 McCormick Bldg.,
Chicago, Ill.

Carlson, Lawrence E.,
Westinghouse Air Brake Co.,
353 Marguerite Ave.,
Wilmerding, Pa.

Carmack, John L.,
Crane & Shovel Foreman,
Union Railroad,
111 Comrie Ave.,
Braddock, Pa.

Carnahan, W. E.,
Treas., Nat. Casket Co., Inc.,
2216 Oliver Bldg.,
Pittsburgh, Pa.

Carr, T. W.,
Mechanical Engineer,
P. & L. E. R. R.,
400 Island Ave.,
McKees Rocks, Pa.

Carran, E. W.,
President,
E. W. Carran & Sons,
Covington, Ky.

Carroll, J. H., Jr.,
Western Freight Traffic Manager,
B. & O. R. R.,
Chicago, Ill.

Carruthers, George R.,
Draftsman,
P. & W. Va. Ry.,
5725 Walnut St.,
E. E., Pittsburgh, Pa.

Carson, John,
Foreman Pattern Shop.,
Ft. Pitt Malleable Iron Co,.
1705 Morningside Ave.,
Pittsburgh, Pa.

Cartwright, Wm. E.,
Pgh. District Mgr.,
National Bearing Metals Corp.,
928 Shore Ave.,
N. S., Pittsburgh, Pa.

Casey, John F.,
Chairman of the Board,
John F. Casey Co.,
P. O. Box 1753,
Pittsburgh, Pa.

Cassidy, David A.,
Gen. Fore., Loco. Dept.,
P. & W. Va. Ry.,
15 W. Main St.,
Carnegie, Pa.

Chaffin, H. B.,
M. M.,
Pennsylvania Railroad,
123 Twelfth St.,
Canton, Ohio

Chalker, A. R.,
Atwood-Bradshaw Corp.,
473 Dawson Ave.,
Bellevue, Pa.

Cherry, Jas. T.,
Roadmaster,
P. & W. Va., Ry.,
626 Grandview Ave.,
Carnegie, Pa.

Chesley, J. O.,
Mgr., Development Division,
Aluminum Co., of America,
Gulf Building,
Pittsburgh, Pa.

Chilcoat, H. E.,
General Manager of Sales,
Koppel Industrial Car & Equipment Co.,
Koppel, Pa.

Chittenden, A. D.,
Supt. Transportation,
B. & L. E. R. R.,
P. O. Box 456,
Pittsburgh, Pa.

Christfield, J. G.,
Mechanical Engineer,
American Rolling Mill Co.,
Butler, Pa.

Christianson, A.,
Chief Engineer,
Standard Steel Car Co.,
Butler, Pa.

Christy, F. X.,
Inspector,
P. R. R.,
4121 Davison St.,
Arsenal Sta.,
Pittsburgh, Pa.

Church, C. R.,
Retired,
319 Larimer Ave.,
Turtle Creek, Pa.

Church, S. L.,
Engr., M. of W.,
Pennsylvania Railroad,
505 So. Negley Ave.,
Pittsburgh, Pa.

Cipro, Thomas,
Air Brake Foreman,
Union Railroad Co.,
Box 204,
Unity, Pa.

Clark, C. C.,
Sales Manager,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Clements, B. A.,
President,
American Arch Co., Inc.,
60 E. 42nd Street,
New York City, N. Y.

Clements, Frank C.,
Foreman,
P. & L. E. R. R.,
844 Island Ave.,
McKees Rocks, Pa.

Coakley, J. A.,
Gen. Traffic Mgr.,
Subsidiary Companies of
U. S. Steel Corp'n.,
Carnegie Building,
Pittsburgh, Pa.

Code, J. G.,
42 E. Steuben St.,
Crafton, Pa.

Coffin, C. W. Floyd,
Vice President,
Franklin Railway Supply
Co., Inc.,
60 E. 42nd St.,
New York, N. Y.

Coffin, Joel S.,
Chairman, Franklin Ry.
Supply Co.,
60 E. 42nd St.,
New York, N. Y.

Colbert, J. T.,
General Superintendent,
Pittsburgh & Shawmut R. R.,
Kittanning, Pa.

Coleman, Jacob C.,
Clerk (Retired),
Union R. R. Co.,
825 Mifflin Ave.,
Wilkinsburg, Pa.

Connely, B. W.
Sawhill Mfg. Co.,
Oliver Building,
Pittsburgh, Pa.

Connors, John M.,
Ass't. Fore. Car Dept.,
Montour Railroad,
208 Sebring St.,
Beechview,
Pittsburgh, Pa.

Conway, J. D.,
Sec'y-Treas., Railway Supply
Manufacturers' Association,
1841 Oliver Bldg.,
Pittsburgh, Pa.

Cook, Sidney J.,
Vice-President,
Egan-Webster Co., Inc.,
Grant Bldg.,
Pittsburgh, Pa.

Coombe, A. B.,
Foreman,
Pressed Steel Car Co.,
1515 Quail Ave.,
Bellevue, Pa.

Cotter, George L.,
District Engineer,
Westinghouse Air Brake Co.,
504 East End Ave.,
Pittsburgh, Pa.

Coulter, A. F.,
M. C. B., Union R. R. Co.,
East Pittsburgh, Pa.

Courtney, Harry,
Shop Supt., P. & L. E.,
520 Giffin Ave.,
Mt. Oliver Sta.,
Pittsburgh, Pa.

Covert, G. W., Jr.,
Safety Inspector,
Youngstown & Suburban Ry.
Company,
21 East Front St.,
Youngstown, Ohio

Cox, Alfred M.,
President,
Pgh. Com'l Heat Treat. Co.,
3710 Liberty Ave.,
Pittsburgh, Pa.

Cox, W. E.,
Asst. Supt.,
Mon. Con. R. R.,
2535 Brownsville Road,
Pittsburgh, Pa.

Craig, W. J.,
Dist. Boiler Inspector,
B. & O. R. R.,
403 Johnston Ave.,
Hazelwood, Pittsburgh, Pa.

Crawford, Alvin B.,
Salesman,
Duquesne Steel
Foundry Co.,
1205 Grant Bldg.,
Pittsburgh, Pa.

Crawford, A. M.,
Supvr. Tel. & Signals,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Crawford, D. F.,
Consulting Engineer,
5243 Ellsworth Ave.,
Pittsburgh, Pa.

Crede, Wm. A.,
Chief Train Clerk,
Office of Supt. Transp'n,
Penna. R. R.,
1605 Clark St.,
Wilkinsburg, Pa.

Crenner, Jos. A.,
Dist. Mgr., Dearborn
Chemical Co.,
618 Farmers Bank Bldg.,
Pittsburgh, Pa.

Cromwell, H. T.,
Asst. Supt. Shops,
B. & O. R. R.,
Glenwood Shops,
Pittsburgh, Pa.

Cruikshank, J. C.,
Div. Engr., P. & W. Va. Ry.,
439 Wabash Bldg.,
Pittsburgh, Pa.

Cunningham, H. B.,
Chief Engineer,
Journal Lubricator Co.,
939 West North Ave.,
Pittsburgh, Pa.

Cunningham, J. Donald,
Sales Engineer,
Southern Wheel Co.,
1510 Grace Ave.,
Lakewood, Ohio.

Cunningham, J. L.,
Asst. to Gen. Supt. Mo. Power,
Pennsylvania Railroad,
519 Penna. Station,
Pittsburgh, Pa.

Cunningham, R. H.,
Salesman,
Union Steel Casting Co.,
62nd & Butler Sts.,
Pittsburgh, Pa

Cunningham, R. I.,
Mech. Expert, W. A. B. Co.,
606 Hampton Ave.,
Wilkinsburg, Pa.

Cunningham, W. P.,
Shop Inspector,
P. & L. E. R. R. Co.,
McKees Rocks, Pa.

Curley, Walter J.,
President and General Mgr.,
Penna.-Conley Tank Car Co.
Koppers Building,
Pittsburgh, Pa.

Cutler, D. E.,
Transportation Dept.,
General Electric Co.,
Oliver Bldg.,
Pittsburgh, Pa.

Dailey, F. J.,
Lubrication Engineer,
Vacuum Oil Co.,
30 Clyde Ave.,
Jamestown, N. Y.

Dalzell, W. E.,
Asst. Planner,
Pressed Steel Car Co.,
1014 Milton St.,
Coraopolis, Pa.

Dambach, C. O.,
General Manager,
P. & W. Va., Ry.,
Wabash Bldg.,
Pittsburgh, Pa.

Damore, S. A.,
Steam Ditcher Engr.,
P. & L. E. R. R.,
P. O. Box 861,
Monessen, Pa.

Damrau, Edward A.,
Dist. Mgr., The Okonite Co.,
First National Bank Bldg.,
Pittsburgh, Pa.

Danforth, G. H.,
Contracting Engineer,
J. & L. Steel Co.,
3rd Ave. and Ross St.,
Pittsburgh, Pa.

Darr, Elsworth E.,
Yardmaster,
P. & L. E. R. R.,
235 Meridan St.,
Mt. Washington,
Pittsburgh, Pa.

Darrall, William G.,
Engineer Mech.,
Edgewater Steel Co.,
347 James St.,
Springdale, Pa.

Daugherty, W. A.,
Gang Fore., Car Dept.,
Union Railroad,
Box 237,
North Bessemer, Pa.

Davies, Benjamin S.,
General Secretary,
P. & L. E. R. R.—Y. M. C. A.,
Dickerson Run, Pa.

Davies, James,
General Auditor,
Alton & Southern R. R.,
Gulf Building,
Pittsburgh, Pa.

Davin, W. E.,
Roadmaster,
P. & L. E. R. R.,
P. & L. E. Terminal Bldg.,
Pittsburgh, Pa.

Davis, Chas. S.,
Traffic Mgr.,
Standard Tin Plate Co.,
Canonsburg, Pa.

Davis, John W.,
General Manager,
Penn Iron & Steel Co.,
Creighton, Pa.

Day, George W. C.,
Telegraph Censor,
B. & O. R. R.,
718 North Ave.,
Wilkinsburg, Pa.

Deckman, E. J.,
Pres., E. J. Deckman Co.,
838 Oliver Bldg.,
Pittsburgh, Pa.

Dehne, G. C.,
Asst. to Vice Pres.,
W. A. B. Co.,
Wilmerding, Pa.

DeLaney, Grover C.,
Foreman Construction,
Ally. Co. Road Dept.,
Box 124,
Glassport, Pa.

DeLaney, V. W.,
Superintendent Transp'n,
Youngstown Sheet & Tube
Company,
Youngstown, Ohio.

Dellmin, T. D.,
Superintendent,
Lake Erie & East. R. R. Co.,
Struthers, Ohio.

Dempsey, P. W.,
Supt. West. Machine Shop,
Westinghouse Air Brake Co.,
259 N. Dithridge St.,
Pittsburgh, Pa.

Dennis, J. G.,
Freight Train Master,
Pennsylvania R. R.,
324 Pennsylvania Station,
Pittsburgh, Pa.

Derr, A. I.,
Ass't. to President,
P. & W. Va. Ry.,
Wabash Bldg.,
Pittsburgh, Pa.

Devans, E. J.,
926 Culver Road,
Rochester, N. Y.

Dickinson, F. W.,
M. C. B.,
B. & L. E. R. R. Co.,
117 Clinton St.,
Greenville, Pa.

Dickinson, T. R.,
Purchasing Agent,
B. & L. E. R. R.,
Union Trust Bldg.,
Pittsburgh, Pa.

Dietrick, W. S.,
Vice-President,
Greenville Steel Car Co.,
Greenville, Pa.

Dihle, James E.,
Locomotive Engineer,
P. & L. E. R. R.,
Fourth Ave.,
Beaver Falls, Pa.

Diller, Clark,
Salesman,
Gustin-Bacon Mfg. Co.,
1021 Filbert St.,
Philadelphia, Pa.

Diven, J. B.,
Supt. Motive Power,
Penna. Railroad,
Pennsylvania Sta.,
Pittsburgh, Pa.

Dobson, F. L.,
General Superintendent,
Pennsylvania Railroad,
2035 East 55th St.,
Cleveland, Ohio

Donovan, J. J.,
Gen. Fore., P. & L. E. R. R.,
426 Jones St.,
Belle Vernon, Pa.

Down, S. G.,
Vice President,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Downes, Daniel F.,
Div. Operator—Pgh. Div.,
Pennsylvania Railroad,
5939 Kirkwood St.,
Pittsburgh, Pa.

Doyle, Timothy E.,
Foreman Painter,
Montour Railroad,
1125 First Ave.,
Coraopolis, Pa.

Draper, Thos.,
President, Draper Mfg. Co.,
Port Huron, Mich.

Dudley, Jesse C.,
Ass't. R. F. of E.,
Penna. R. R.,
603 Hill Ave.,
Wilkinsburg, Pa.

Dunbar, Harold F.,
Sales Rep., McConway &
Torley Corp'n.,
48th St. & A. V. R. R.,
Pittsburgh, Pa.

Dunlap, Robert J., Jr.,
Terminal Foreman,
Montour Railroad Co.,
Willock, Pa.

Dunn, Samuel O.,
Editor, Railway Age Gazette,
105 W. Adams St.,
Chicago, Ill.

Durkin, Jas. E.,
Asst. Superintendent,
Ft. Pitt Mall. Iron Co.,
905 Second St.,
McKees Rocks, Pa.

Duryea, O. C.,
President,
O. C. Duryea Corp'n,
P. O. Box 56,
Butler, Pa.

Eagan, D. F.,
Asst. T. M. & Div. Opr.,
Penna. System,
39 Mt. Oliver St.,
Pittsburgh, Pa.

Earley, J. T.,
Ind. Sales Rep.,
Indianapolis Varnish Co.,
Box 114,
Saxonburg, Pa.

Eckes, Joseph M.,
Salesman,
Railway Products Co.,
Grant Bldg.,
Pittsburgh, Pa.

Edgett, Joseph W.,
Sales Engineer,
Walworth Co.,
604 Chamber of Commerce Bldg.,
Pittsburgh, Pa.

Edgin, Geo. A.,
Asst. Sales Manager,
The Duff-Norton Mfg. Co.,
2709 Preble Ave.,
N. S., Pittsburgh, Pa.

Edmiston, R. J.,
Special Representative,
U. S. Graphite Co.,
Fulton Bldg.,
Pittsburgh, Pa

Edwards, Clifton H.,
Storekeeper, Ft. Pitt
Malleable Iron Co.,
1406 Chartiers Ave.,
McKees Rocks, Pa.

Eichenlaub, W. C.,
Sales Manager,
Pittsburgh Steel Foundry Corp.,
Glassport, Pa.

Ekey, J. S.,
Engineer of Bridges,
B. & L. E. R. R.,
4 College Ave.,
Greenville, Pa

Ellis, C. B.,
Gen. Traffic Manager,
Gulf Refining Co.,
P. O. Box 1214,
Pittsburgh, Pa.

Emery, E.,
Railway Supplies,
6511 Darlington Road,
Pittsburgh, Pa.

Emsheimer, Louis,
Machinist,
Pennsylvania Railroad,
1439½ Elm St.,
Wilkinsburg, Pa.

En Dean, J. F.,
Inspecting Engineer,
P. & L. E. R. R.,
436 Edgemont St.,
Knoxville,
Pittsburgh, Pa.

Endsley, Louis E., Prof.,
Consulting Engr.,
516 East End Ave.,
Pittsburgh, Pa.

England, Alexander,
Chief Engineer,
W. A. B. Co.,
428 Biddle Ave.,
Wilkinsburg, Pa.

Erickson, L. S.,
Traveling R. R. Sec'y.,
Y. M. C. A.,
407 Calder Bldg.,
Harrisburg, Pa.

Ernest, E. E.,
Supt. Freight Transp'n.
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Evans, David F.,
Dist. Manager,
The Duff-Norton Mfg. Co.,
N. S., Pittsburgh, Pa.

Evans, Robert E.,
Yardmaster,
Pennsylvania Railroad,
814 Norwich St.,
South Hills Station,
Pittsburgh, Pa

Faix, Joseph,
P. W. I. F., P. & L. E. R. R.,
639 Michigan Ave.,
Glassport, Pa.

Falkner, Andrew J.,
Clerk,
B. & O. R. R.,
4014 Coleman St.,
Pittsburgh, Pa.

Farmer, C. C.,
Director of Engineering,
W. A. B. Co.,
Wilmerding, Pa.

Farrell, G. R.,
Sales Agent,
Nat'l Mall. & Steel Cstgs. Co.,
10600 Quincey Ave.,
Cleveland, Ohio

Farrington, Robert J.,
General Foreman,
P. & L. E. R. R.,
1318 Vine St.,
McKees Rocks, Pa.

Fay, Frank L., Hon.,
Chairman of the Board,
Greenville Steel Car Co.,
Greenville, Pa.

Fendner, W. J.,
Mechanical Engineer,
Schaefer Equipment Co.,
Koppers Bldg.,
Pittsburgh, Pa.

Fenton, H. H.,
District Supt.,
Pittsburgh Railways,
435 Sixth Ave.,
Pittsburgh, Pa.

Ferguson, James H., Jr.,
Draftsman,
Union Railroad Co.,
1435 Foliage St.,
Wilkinsburg, Pa.

Ferguson, R. G.,
Electrician,
Pennsylvania Railroad,
2446 East St.,
N. S., Pittsburgh, Pa.

Ferrick, John T.,
Freight Cashier,
P. & L. E. R. R.,
Terminal Annex,
Pittsburgh, Pa.

Fettinger, H. O.,
Rep., Ashton Valve Co.,
21 Albany St.,
New York, N. Y.

Fields, S. H.
Vice-President,
Koppers Products Co.,
Koppers Bldg.,
Pittsburgh, Pa.

Fieldson, P. H.,
Asst. Master Car Builder,
P. & L. E. R. R.,
1303 Broadway,
McKees Rocks, Pa.

Filson, Harry T.,
Engine Dispatcher,
Montour Railroad,
George St.,
Coraopolis, Pa.

Finegan, Leo,
Superintendent,
Flannery Bolt Co.,
Keystone Athletic Club,
Pittsburgh, Pa.

Fink, Peter J.,
General Car Foreman,
P. & L. E. R. R.,
328 Amabell St.,
19th Ward,
Pittsburgh, Pa.

Fischer, G. E.,
Clerk, Union Railroad,
2202 Hampton St.,
Swissvale, Pa.

Fisher, E. M.,
Asst. R. F. of E.,
Penna. Railroad System,
909 E. Washington St.,
New Castle, Pa.

Fisher, G. Malcolm,
Blacksmith Foreman,
Union R. R.,
R. F. D. 1—Box 466,
Wilkinsburg, Pa.

Fisher, John J.,
Trav. Car Inspector,
7234 McClure Ave.,
Swissvale, Pa.

Fitzgerald, T.,
Vice President,
Pittsburgh Railways Co.,
435 Sixth Ave.,
Pittsburgh, Pa.

Fitzsimmons, E. S.,
Mgr. Sales,
Flannery Bolt Co.,
Bridgeville, Pa.

Flaherty, P. J.,
Pres. and General Mgr.,
Johnson Bronze Co.,
So. Mill Street,
New Castle, Pa.

Flannery, J. Rogers,
President,
Flannery Bolt Co.,
Flannery Bldg.,
Pittsburgh, Pa.

Fleckenstein, August,
P. W. Insp'r., P. & L. E. R. R.,
1108 Crucible St., 20th Wd.,
Pittsburgh, Pa.

Flinn, R. H.,
General Superintendent,
Penna. Railroad,
Penn. Station,
Pittsburgh, Pa.

Follett, W. F.,
Asst. Supt.,
Aliquippa & Southern R. R.,
106 King St.,
Aliquippa, Pa.

Foote, Frederick D.,
Asst. to Vice President,
United States Steel Corp.,
71 Broadway,
New York, N. Y.

Forsberg, R. P.,
Chief Engineer,
P. & L. E. R. R.,
P. & L. E. Terminal Bldg.,
Pittsburgh, Pa.

Fortescue, Charles L.,
Consulting Transmission Engr.
Westinghouse Electric &
Mfg. Co.,
East Pittsburgh, Pa.

Foster, F. L.,
Supt. Frt. Transportation,
P. & L. E. R. R.,
Pittsburgh, Pa.

Fowler, W. E.,
Vice-Pres. & Gen. Mgr.,
Pgh., Lisbon & Western
R. R.,
21 East Front St.,
Youngstown, Ohio

Fox, George W.,
Secretary,
Davis Brake Beam Co.,
146 Second Avenue,
Westmont,
Johnstown, Pa.

Frauenheim, A. M.,
Vice President,
Auto-Tite Joints Co.,
7501 Thomas Blvd.,
Pittsburgh, Pa.

Frauenheim, Pierce H.,
Auto-Tite Joints Co.,
7501 Thomas Blvd.,
Pittsburgh, Pa.

Freshwater, F. H.,
Sales Agent,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Fretz, R. I.,
District Sales Representative,
Reading Iron Co.,
1480 Mulford Road,
Columbus, Ohio

Fritz, A. A.,
Clerk, Mon. Conn. R. R.,
133 Stewart Ave.,
Mt. Oliver Station,
Pittsburgh, Pa.

Fry, Lawford H.,
Railway Engineer,
Edgewater Steel Co.,
P. O. Box 249,
Pittsburgh, Pa.

Fults, John H.,
Union National Bank,
Wood Street,
Pittsburgh, Pa.

Funfer, James,
Gang Fore., Car Dept.,
Union Railroad Co.,
R. F. D. No. 1,
Turtle Creek, Pa.

Furch, George J.,
Gang Fore., Penna. System,
705 High St.,
Freeport, Pa.

Gaffney, Thomas H.,
Roadmaster,
Montour Railroad,
1364 Fourth Ave.,
Coraopolis, Pa.

Gallowich, Louis J.,
Car Inspector,
Pennsylvania Railroad,
3 Matson St.,
N. S. Pittsburgh, Pa.

Gammiere, E. J.,
Fore., Core Dept.,
Ft. Pitt Malleable Iron Co.,
107 Jane St.,
McKees Rocks, Pa.

Gardner, George R.,
Chief Clerk—Traffic Dept.,
Pittsburgh Coal Co.,
1024 Oliver Bldg.,
Pittsburgh, Pa.

Gardner, Jas. E.,
Spl. Rep. Schaefer Equipt. Co.
Koppers Bldg.,
Pittsburgh, Pa.

Garlow, Andrew,
Airbrake Inspector,
Union Railroad,
North Bessemer, Pa.

Gates, C. F.,
Asst. Chief Clerk,
P. & L. E. R. R.,
Pittsburgh, Pa.

Gatfield, Philip I.,
Mechanic,
Keystone Sand & Supply Co.,
219 Zara St.,
Knoxville,
Pittsburgh, Pa.

Geddes, James R.,
V. P. and Gen. Supt.,
Mon. Con. R. R. Co.,
3540 Second Ave.
Pittsburgh, Pa.

Geisler, Jos. J.,
Mech. Engineer,
Ft. Pitt Mall. Iron Co.,
1023 Chartiers Ave.,
McKees Rocks, Pa.

Gellatly, Wm. R.,
President,
Superior Railway Products
Corp.,
Thomas Boulevard,
Pittsburgh, Pa.

George, R. H.,
Assistant Engineer,
P. & L. E. R. R.,
Terminal Building,
Pittsburgh, Pa.

Gerber, Harry L.,
Template Checker,
Pressed Steel Car Co.,
R. D. No. 1,
Mercer, Pa.

Germak, George A.,
Car Inspector,
P. & L. E. R. R.,
529 Indiana Ave.,
Glassport, Pa.

Gilg, Henry F.,
Railway Supplies,
1424 Orchlee St.,
N. S., Pittsburgh, Pa.

Gill, C. A.,
S. M. P. & Rolling Equip't.,
Reading Co.,
Reading, Pa.

Gillespie, J. Porter,
Ass't. Gen'l. Supt.,
Lockhart Iron & Steel Co.,
P. O. Box 1243,
Pittsburgh, Pa.

Gillespie, John M.,
Vice President,
Lockhart Iron & Steel Co.,
P. O. Box 1243,
Pittsburgh, Pa.

Glaser, J. P.,
Auditor Disbursements,
P. & L. E. R. R.,
909 Bellaire Ave.,
Pittsburgh, Pa.

Gleeson, Harry L.,
Sales Agent,
The Lorain Steel Co.,
Frick Bldg.,
Pittsburgh, Pa.

Glenn, J. H.,
R. F. of E. P. & W. Va. Ry.,
20 Obey St.,
Pittsburgh, Pa.

Glessner, Geo. P.,
Wrecker Engineer,
Union Railroad,
R. D. No. 2,
Turtle Creek, Pa.

Goda, P. H.,
Foreman, P. R. R.,
311 South Ave.,
Wilkinsburg, Pa.

Goff, J. P.,
Asst. T. M., P. & L. E. R. R.,
615 Montour St.,
Coraopolis, Pa.

Goodman, O. F.,
Sales Engineer,
Worthington Pump &
Machinery Corp.,
Koppers Bldg.,
Pittsburgh, Pa

Gorby, Frank E.,
Supt., Union R. R.,
East Pittsburgh, Pa.

Gorman, Charles,
District Manager,
The Garland Co.,
302 McCance Bldg.,
Pittsburgh, Pa.

Goron, F. W.,
Asst. Gen. Foreman,
P. & L. E. R. R.,
874 Railroad St.,
McKees Rocks, Pa.

Graham, A. C.,
Traffic Manager,
Youngstown Sheet and
Tube Company,
Stambaugh Bldg.,
Youngstown, Ohio.

Graham, Chas. J.,
Special Representative,
Pressed Steel Car Co.,
2511 Grant Bldg.,
Pittsburgh, Pa.

Graham, H. E.,
Asst. to Pres. & Gen. Traf
Mgr.,
Jones & Laughlin Steel
Corp.,
3rd Ave. & Ross St.,
Pittsburgh, Pa.

Graham, Harry C.,
Pittsburgh Screw and Bolt
Corporation,
P. O. Box 72,
Pittsburgh, Pa

Graham, James,
Inspector, P. R. R. System,
806 Southern Ave.,
Mt. Washington Sta.,
Pittsburgh, Pa

Gray, Guy M.,
S. M. P.,
B. & L. E. R. R. Co.,
Greenville, Pa.

Grieve, Robert E.,
Passenger Train Master,
P. R. R.,
740 East End Ave.,
Pittsburgh, Pa.

Grimshaw, F. G.,
Works Mgr., P. R. R.,
Altoona, Pa.

Guinnip, M. S.,
Sales Engineer,
Ingersoll-Rand Co.,
706 Chamber of Commerce Bldg.,
Pittsburgh, Pa.

Gunnison, Walter L.,
Representative,
Enterprise Railway
Equipment Co.,
59 E. Van Buren St.,
Chicago, Ill.

Guy, W. S.,
Traffic Manager,
Carnegie Steel Co.,
812 Carnegie Bldg.,
Pittsburgh, Pa.

Gwaltney, R. H.,
Vice President,
The Symington Co.,
230 Park Ave.,
New York, N. Y.

Hackett, C. M.,
Boiler Maker Fore.,
Penna. R. R.,
618 Pennsylvania Ave.,
Oakmont, Pa.

Hale, Chas. E.,
Baldwin Loco. Works,
Paschall Station,
Philadelphia, Pa.

Hall, Charles B.,
Supt. Coal Docks,
Union Railroad Co.,
1600 Vermont Ave.,
McKeesport, Pa.

Hall, Chester C.,
Truck Driver,
J. T. & A. Hamilton Co.,
26th & Smallman Sts.,
Pittsburgh, Pa.

Haller, C. T.,
President,
Colonial Supply Co.,
217 Water St.,
Pittsburgh, Pa.

Haller, Nelson M.,
Sup'r. Scrap & Reclamation,
P. & L. E. E. R. R.,
5853 Aylesboro Ave.,
Pittsburgh, Pa.

Hamilton, Hugh M.,
General Foreman, Pass. Cars,
Pressed Steel Car Co.,
3026 Merwyn Ave.,
Corliss Station,
Pittsburgh, Pa.

Hamilton, W. H.,
Supt. Roadway & Structures,
Montour Railroad,
Coraopolis, Pa.

Hammond, H. S.,
Sales Agent,
Pressed Steel Car Co.,
80 Broad St.,
New York, N. Y.

Hancock, Milton L.,
Office Engineer,
Westinghouse Air Brake Co.,
557 Broadway Extension,
East McKeesport, Pa.

Hankins, F. W.,
Chief of Motive Power,
Pennsylvania Railroad,
1617 Pennsylvania Blvd.,
Philadelphia, Pa.

Hansen, Wm. C.,
Sales Engr., A. Stucki Co.,
419 Oliver Bldg.,
Pittsburgh, Pa.

Harbaugh, Chas. P.,
Wreck Master,
Union Railroad,
East Pittsburgh, Pa.

Hare, J. K. B.,
Central Transp'n Manager,
Westinghouse Elec. &
Mfg. Co.,
Grant Bldg.,
Pittsburgh, Pa.

Harger, E. S.,
General Foreman,
P. & L. E. R. R.,
1455 Myrtle Ave.,
New Brighton, Pa.

Harman, H. H.,
Engineer—Track,
B. & L. E. R. R.,
Greenville, Pa.

Harper, A. M.,
Mgr. of Specialties Sales,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Harper, G. C.,
General Supt.,
Montour Railroad,
1711 State Ave.,
Coraopolis, Pa.

Harper, J. T.,
Asst. To Mech. Supt.,
Montour Railroad,
R. F. D. No. 1,
McKees Rocks, Pa.

Harper, James W.,
Medical Examiner,
Penna. R. R.,
5121 Bayard St.,
Pittsburgh, Pa.

Harter, Arnold,
Ass't Fore., W. A. B. Co.,
353 Marguerite Ave.,
Wilmerding, Pa.

Hastings, Walter S.,
R. F. of E.,
Aliquippa & Southern R. R.,
Aliquippa, Pa.

Hauser, G. Bates,
Engineer, Development Div.,
Aluminum Co. of America,
New Kensington, Pa.

Hays, Harry E.,
R. F. of E.,
Pennsylvania Railroad,
3148 Huxley St.,
Corliss Station,
Pittsburgh, Pa.

Hayward, Carlton,
C. C. to Gen. Supt. Motive Power,
Pennsylvania R. R.,
7412 Penfield Place,
Pittsburgh, Pa.

Heckmon, C. J.,
Draftsman,
Spang, Chalfant Co.,
129 Sixth St.,
Aspinwall, Pa.

Heffelfinger, A. E.,
Sales Manager,
The Symington Co.,
230 Park Ave.,
New York City.

Hektner, Joel,
Asst. Engr., Ry. Division,
Timken Roller Bearing Co.,
Canton, Ohio.

Henderson, Geo. L.,
Engr., P. & L. E. R. R.,
228 Sheridan Ave.,
New Castle, Pa.

Henry, C. J.,
Supervisor of Track,
Pennsylvania Railroad,
1990 Upland Way,
Averbrook,
Philadelphia, Pa.

Henry, C. L.,
Asst. M. M., Penna. R. R.,
Mingo Junction, Ohio.

Henry, Frank P.,
General Foreman,
Carnegie Steel Co.,
36 Danvers Ave.,
Ingram, Pa.

Hepburn, P. W.,
Lubricating Engineer,
Gulf Refining Co.,
6963 Frankstown Ave.,
Pittsburgh, Pa.

Herald, M. A.,
President, United Car & Equipment Company,
Westinghouse Bldg.,
Pittsburgh, Pa.

Herbert, T. C.,
Division Superintendent,
Pennsylvania Railroad,
1013 Penn Ave.,
Pittsburgh, Pa.

Herlehy, David T.,
P. W. I. F., P. & L. E. R. R.,
Ohio Ave.,
Glassport, Pa.

Herrold, A. E.,
M. M. & M. C. B.,
Mon. Conn. R. R.,
3915 Winterburn Ave.,
Pittsburgh, Pa.

Hervey, R. S.,
Auditor Freight Accounts,
P. & L. E. R. R.,
722 Main St.,
Coraopolis, Pa.

Hettler, R. C.,
Foreman, Car Dept.,
Penna. Railroad,
c/o Y. M. C. A.,
600 W. North Ave.,
N. S., Pittsburgh, Pa.

Hiester, E. G.,
Ass't Dining Car Agent,
Penna. R. R.,
3125 Perrysville Ave.,
Pittsburgh, Pa.

Hilbert, Rudolph F.,
Engineer,
Fort Pitt Spring Co.,
833 Neely Heights,
Coraopolis, Pa.

Hill, Harold A.,
Mechanical Engineer,
Fort Pitt Malleable
Iron Co.,
1312 Vine St.,
McKees Rocks, Pa.

Hill, W. D.,
Oakmont Ave.,
Oakmont, Pa.

Hilstrom, Anton V.,
Foreman,
P. & L. E. R. R.,
P. O. Box 192,
Glenfield, Pa.

Hodge, Edwin, Jr.,
President,
Pittsburgh Forgings Co.,
Grant Bldg.,
Pittsburgh, Pa.

Hoffstot, H. P.,
Vice President,
Pressed Steel Car Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Hogg, Francis,
Designer,
General Electric Co.,
2326 Station Road,
Wesleyville, Pa

Hohn, George W.,
Track Supervisor,
B. & L. E. R. R.,
538 East Pearl St.,
Butler, Pa.

Holiday, Harry,
Manager of Works,
The American Rolling
Mill Company,
Butler, Pa.

Holmes, E. H.,
Sales Department,
Ft. Pitt Malleable Iron Co.,
3662 Middletown Road,
Corliss Station,
Pittsburgh, Pa.

Holohan, S. V.,
Passenger Conductor,
B. & O. R. R.,
364 Norwood Ave.,
Buffalo, N. Y.

Honsberger, G. W.,
Salesman,
Westinghouse E. & M. Co.,
Gulf Bldg.,
Pittsburgh, Pa.

Hoover, Jacob W.,
Chief Traffic Dispatcher,
Carnegie Steel Co.,
816 Carnegie Bldg.,
Pittsburgh, Pa

Horan, F. T.,
Superintendent,
Lake Terminal
Railroad Co.,
Lorain, Ohio

Horner, William,
General Yardmaster,
Mon. Con. R. R. Co.,
1540 Belasco Ave.,
Pittsburgh (16), Pa.

Hosford, Charles C.,
General Scale Inspector,
Pennsylvania Railroad,
6625 Ohio River Blvd.,
Ben Avon, Pa.

Howard, L. F.,
Chief Engineer,
Union Switch & Signal Co.,
Swissvale, Pa.

Howe, Harry,
Eng'r. of Ry. Equip't.,
Manganese Steel Forge Co.,
Richmond & Castor Ave.,
Philadelphia, Pa.

Huber, H. G.,
Asst. General Foreman,
Penna. Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Huff, A. B.,
Foreman,
Pennsylvania Railroad,
209 Midland Ave.,
Carnegie, Pa.

Hughes, I. Lamont,
President,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Hughes, J. E.,
General Agent,
P. & L. E. R. R.,
504 Union Bank Bldg.,
Youngstown, Ohio.

Humphrey, A. L.,
Executive Director,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Hunt, Lawrence,
Gen. Fore., Tank Car Dept.,
Pressed Steel Car Co.,
272 Balph Ave.,
Bellevue, Pa.

Hursh, P. S.,
Supervisor Boilers,
B. & O. R. R.,
17 Linden Ave.,
DuBois, Pa.

Hursh, Samuel R.,
Div. Engr., Pgh. Div.,
Penna. Railroad Co.,
324 N. Sheridan Ave.,
Pittsburgh, Pa.

Huston, Frederick T.,
Master Mechanic,
Pennsylvania Railroad,
611 Pennsylvania Station,
Pittsburgh, Pa.

Hykes, W. H.,
Assistant Trainmaster,
Penna. R. R. Co.,
526 Sixth St.,
Oakmont, Pa.

Inks, S. W.,
Master Mechanic,
Monongahela Railway Co.,
South Brownsville, Pa.

Irwin, Robert D.,
Foreman,
Westinghouse Air Brake Co.,
521 Holmes St.,
Wilkinsburg, Pa.

Jack, Arthur C.,
Engineer, Track Appliances,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Jenkner, Oscar,
G. Y. M., Union R. R.,
503 Hunter St.,
Turtle Creek, Pa.

Jenness, D. H.,
R. F. of E., Penna. R. R.,
620 Sheridan Ave.,
Pittsburgh, Pa.

Johnson, E. A.,
15 N. Euclid Ave.,
Bellevue, Pittsburgh, Pa.

Johnson, George T.,
Vice President, The
Buckeye Steel Castings Co.,
South Parsons Ave.,
Columbus, Ohio

Johnson, I. S.,
Resident Material Inspector,
The Pennsylvania Railroad,
Room 402, 1013 Penn Ave.,
Pittsburgh, Pa.

Johnson, J. W.,
City Mgr., Amer.
Rwy. Express Co.,
926 Penn Ave.,
Pittsburgh, Pa.

Johnson, Wm. M.,
Gen. Superintendent,
B. & L. E. R. R.,
Greenville, Pa.

Johnston, Geo. E.,
Clerk, Union Railroad,
Box 92,
Lincoln Place, Pa.

Johnston, Harvey F.,
Rate Clerk,
P. & L. E. R. R.,
McKees Rocks, Pa.

Johnston, W. A.,
Gang Foreman,
Penna. R. R.,
R. D. 2,
Pitcairn, Pa.

Jones, H. W.,
General Superintendent,
Pennsylvania Railroad,
Indianapolis, Ind.

Jones, L. E.,
Engr. Office of Vice Pres.,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Jones, Louis E.,
Department Manager,
American Steel Foundries,
North Wrigley Bldg.,
Chicago, Ill.

Jones, William M.,
Clerk, Union Railroad,
5020 Glenwood Ave.,
Hazelwood Sta.,
Pittsburgh, Pa.

Joyce, P. H.,
President,
C. G. W. R. R.,
122 So. Michigan Ave.,
Chicago, Ill.

Kapp, A. C.,
General Foreman,
B. & L. E. R. R.,
R. F. D. No. 1,
Verona, Pa.

Karnes, W. T.,
General Foreman,
P. & L. E. R. R.,
330 Ohio Ave.,
Glassport, Pa.

Kaup, Harry E.,
Superintendent,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Kavanagh, D.,
Storekeeper,
Union Railroad,
East Pittsburgh, Pa.

Keenoy, R. P.,
V. P. & G. S., D. S. R. R.,
902 Jancey St.,
E. E., Pittsburgh, Pa.

Kelin, H. S.,
Draftsman, Union R. R. Co.,
R. F. D. 4, Box 208-L,
Millvale,
Pittsburgh, Pa.

Kellenberger, K. E.,
Advertising Manager,
Union Switch & Signal Co.,
P. O. Box 127,
Wilkinsburg, Pa.

Keller, R. B.,
Supervisor,
Air Reduction Sales Co.,
1116 Ridge Ave.,
N. S., Pittsburgh, Pa.

Keller, R. E.,
Lead Car Inspector,
P. & L. E. R. R.,
560 Stokes Ave.,
Braddock, Pa.

Kelly, H. B.,
Gen. R. F. of E.,
P. & L. E. R. R.,
3115 Ashlyn St.,
Corliss Station,
Pittsburgh, Pa.

Kelly, J. P.,
Asst. Superintendent,
P. & L. E. R. R.,
922 School St.,
Coraopolis, Pa.

Kelly, J. R.,
Secretary to Chairman,
Westinghouse Electric &
Mfg. Co.,
1720 Gulf Bldg.,
Pittsburgh, Pa.

Kelly, J. W.,
Boiler Tube Expert,
National Tube Co.,
515 N. Grove Ave.,
Oak Park, Ill.

Kelly, Leo J.,
Superintendent,
Ft. Pitt Mall. Iron Co.,
3036 Bergman St.,
Pittsburgh, Pa.

Kempton, J. W.,
Gen. Sec'y, Y. M. C. A.,
P. & L. E. R. R.,
Newell, Pa.

Kennedy, A. R.,
Traffic Manager,
Pittsburgh Steel Co.,
Union Trust Building,
Pittsburgh, Pa.

Kennedy, F. D.,
Supt. Railwav Dept.,
Westinghouse Elec. &
Mfg. Co.,
220 Bevington Road,
Wilkinsburg, Pa.

Kennedy, F. J.,
Auditor Pass. Accounts,
P. & L. E. R. R.,
Box 206,
New Brighton, Pa.

Kentlein, John
Chief Draftsman,
H. K. Porter Co.,
Hawthorne Road,
Millvale, Pa.

Kerby, Frederick,
Asst. to Chief of Motive
Power and Equipment,
B. & O. R. R.,
218 Pennsylvania Ave.,
Cumberland, Md.

Kern, Roy S.,
Chairman,
Coal, Coke & Iron Ore
Com.,
Wabash Bldg.,
Pittsburgh, Pa.

Kernan, John L.,
340 Russellwood Ave.,
McKees Rocks, Pa.

Kerr, Clark R.,
Asst. Car Foreman,
Union Railroad Co.,
East Pittsburgh, Pa.

Ketchpel, Paul A.,
Development Engineer,
Standard Stoker Co.,
350 Madison Ave.,
New York, N. Y.

Kight, R.,
Asst. Gen. Yard Master,
Western Maryland Ry. Co.,
Thomas, W. Va

Kilborn, W. T.,
Vice President,
Flannery Bolt Co.,
Bridgeville, Pa.

Kimling, Carl,
Asst. Mgr., Central Warehouse
P. & L. E. R. R.,
85 Harwood St.,
Pittsburgh, Pa.

King, C. F., Jr.,
General Engineer,
Westinghouse Elec. & Mfg.
Company,
East Pittsburgh, Pa.

Kirk, W. B.,
Test Engineer,
Westinghouse Air Brake
Company,
200 Delaware Ave.,
East McKeesport, Pa.

Kirkpatrick, H. F.,
Sales Department,
Union Steel Casting Co.,
62nd and Butler Sts.,
Pittsburgh, Pa

Kirsch, O. W.,
Asst. Train Master,
Pennsylvania Railroad,
1460 Foliage St.,
Wilkinsburg, Pa.

Klassen, Fred G.,
Locomotive Foreman,
P. & W. Va. Ry.,
Carnegie, Pa.

Klein, Nicholas P.,
Foreman Car Repairs,
Pennsylvania Railroad,
50 South 33rd St.,
Pittsburgh, Pa.

Kleinhans, Harry,
President,
H. Kleinhans Co.,
419 Union Trust Bldg.,
Pittsburgh, Pa.

Knox, Wm. J.,
112 Second Ave.,
DuBois, Pa.

Kohl, H. J.,
Gen. Car Foreman,
P. & L. E. R. R.,
1106 Tweed St.,
Pittsburgh, Pa.

Kohute, Hilary Geo.,
Clerk,
Union Railroad,
East Pittsburgh, Pa.

Kramer William E.,
Representative,
Acme Steel Co.,
3674 Middletown Road,
Corliss Station,
Pittsburgh, Pa.

Kraus, Raymond E.,
Mechanical Draftsman,
P. & L. E. R. R.,
223 Fisk St.,
Arsenal Station,
Pittsburgh, Pa.

Krause, Harry A.,
Gang Fore., Penna. System,
160 Race St.,
Edgewood, Pittsburgh, Pa.

Kromer, Wm. F.,
Mechanical Engineer,
H. K. Porter Co.,
108 Tenth St.,
Aspinwall, Pa.

Kroske, J. F.,
Mgr., P. T. Sales,
Ingersoll-Rand Co.,
706 Chamber of Commerce
Bldg.,
Pittsburgh, Pa.

Kruse, J. F. W.,
Supt., Woodings-Verona
Tool Works,
528 Washington Ave.,
Oakmont, Pa.

Kulp, J. G.,
Train Master,
Pennsylvania Railroad,
810 Rebecca Ave.,
Wilkinsburg, Pa.

Kummer, Jos. H.,
General Sales Representative,
Fort Pitt Mall. Iron Co.,
209 Greydon Ave.,
McKees Rocks, Pa.

Kusick, Harry F.,
Engineer,
Union Switch & Signal Co.
Swissvale, Pa.

Lackner, Ray A.,
District Sales Manager,
Penna. Forge Corp.,
5724 Bartlett St.,
Pittsburgh, Pa.

Lally, C. V.,
General Manager of Sales,
Pgh. Steel Products Co.,
605 N. Negley Ave.,
Pittsburgh, Pa.

Lanahan, Frank J.,
President, Fort Pitt Malleable
Iron Co.,
P. O. Box 492,
Pittsburgh, Pa.

Lanahan, J. S.,
Vice President, Fort Pitt
Mall. Iron Co.,
127 Elysian Ave.,
Pittsburgh, Pa.

Landis, W. C.,
Asst. Works Manager,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Lang, W. C.,
Master Car Builders,
P. & L. E. R. R.,
McKees Rocks, Pa.

Lanning, J. Frank,
President,
J. Frank Lanning & Co.,
327 First Ave.,
Pittsburgh, Pa.

Larsen, Jacob C.,
Sales Engineer,
The Buckeye Steel
Castings Co.,
So. Parsons Ave.,
Columbus, Ohio

Larsen, O. C.,
Secretary & Treasurer,
The North American Coal
Corp.,
823 Wabash Bldg.,
Pittsburgh, Pa.

Laughner, Carl L.,
Gen'l Foreman, P. S. C. Co.,
1009 James St.,
N. S., Pittsburgh, Pa.

Laurent, Jos. A.,
Gen. Fore. Fin. Dept.,
Fort Pitt Mall. Iron Co.,
206 Bruce St.,
McKees Rocks, Pa.

Lawler, Joseph A.,
Sup't Trans.,
Carnegie Steel Co.,
Edgar Thomson Works,
Braddock, Pa.

Layng, Frank R.,
Chief Engineer,
B. & L. E. R. R.,
Greenville, Pa.

Leach, J. T.,
M. M., Penna. System.
1001 Broadway,
Juniata P. O.,
Altoona, Pa.

Leban, J. L.,
Ass't Dis't Supt.,
Pullman Co.,
1434 Gulf Bldg.,
Pittsburgh, Pa.

Lee, L. A.,
P. & L. E. R. R.,
645 Bigelow Street,
Pittsburgh, Pa.

Lees, Thomas,
Reymer & Brothers, Inc.,
123 Bascom St.,
Pittsburgh, (14) Pa.

Leet, C. S.,
Land Agent,
B. & L. E. R. R.,
P. O. Box 456,
Pittsburgh, Pa.

Lehr, Harry W.,
General Foreman,
Passenger Car Inspr's.,
P. R. R. Co.,
516 Arlington Apts.,
Center & Aiken Aves.,
Pittsburgh, Pa.

Leiper, C. I.,
Gen. Mgr., Central Region,
P. R. R. System,
Pennsylvania Station,
Pittsburgh, Pa.

Lewis, Goodrich Q.,
Chief Engineer,
W. H. Miner, Inc.,
209 South La Salle St.,
Chicago, Ill.

Lewis, Herbert,
Vice President and Secretary,
The Durametallic Corp'n.,
Federal Trust Bldg.,
Newark, N. J.

Lightsell, S. M.,
Boiler Foreman,
P. R. R.,
2674 Wind Gap Road,
Ingram, Pittsburgh, Pa.

Lillie, G. W.,
Sales Engineer,
Union Steel Casting Co.,
62nd & Butler Sts.,
Pittsburgh, Pa.

Lindahl, A. M.,
Y. M., Union R. R.,
1732 Laketon Road,
Wilkinsburg, Pa.

Lindsay, J. H.,
Div. Accountant,
B. & O. R. R.,
1518 Center St.,
Wilkinsburg, Pa.

Linsenbigler, Allen J.,
Gang Foreman,
Union Railroad,
212 Dixon Ave.,
East Pittsburgh, Pa.

Loeffler, George O.,
District Representative,
Climax Molybdenun Co.,
905 Union Trust Bldg.,
Pittsburgh, Pa.

Logan, J. W., Jr.,
Engineer,
Union Switch & Signal Co.,
Swissvale, Pa.

Long, R. M.,
"Retired" Air Brake
Inspector and Instructor,
P. & L. E. R. R.,
3118 Pioneer Ave.,
South Hills Branch,
Pittsburgh, Pa.

Long, Walter,
Walter Long Mfg. Co.,
1313 Burgham St.,
S. S., Pittsburgh, Pa.

Longdon, Clyde V.,
Asst. Engineer, T. & E. D.
Dept.,
Westinghouse Air Brake Co.
561 Broadway Extension,
East McKeesport, Pa.

Lortz, Elmer A.,
Safety Engineer,
Pressed Steel Car Co.,
3924 Winshire St.,
N. S., Pittsburgh, Pa.

Lower, N. M.,
Asst. to President,
Standard Stoker Co.,
350 Madison Ave.,
New York, N. Y.

Lowndes, T. H.,
Asst. Superintendent,
National Bearing Metals
Corp.,
928 Shore Ave.,
N. S., Pittsburgh, Pa.

Lowry, Wm. F., Jr.
Sales Agent,
American Car &
Foundry Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa

Lundeen, Carl J.,
Office Asst. to General Agent,
P. & L. E. R. R.,
504 Union National
Bank Bldg.,
Youngstown, Ohio

Lustenberger, L. C.,
Special Representative,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Lynn, Samuel,
Supt. of Rolling Stock,
P. & L. E. R. R.,
McKees Rocks, Pa.

Lynn, William,
General Car Foreman,
P. & L. E. R. R.,
Box 277, R. D. 3,
Coraopolis, Pa.

MacDonald, William C.,
Special Agent, Contracts,
Penna. R. R. System,
254 Allison Ave.,
Emsworth, Pa.

Mackert, A. A.,
Asst. to Design Engineer,
W. A. B. Co.,
450 Caldwell Ave.,
Wilmerding, Pa.

Maliphant, C. W.,
Test Dept.,
W. A. B. Co.,
101 Herman Ave.,
Wilmerding, Pa.

Mann, Henry S.,
Dist. Sales Mgr.,
Standard Stoker Co., Inc.,
1903 McCormick Bldg.,
Chicago, Ill.

Manning, Jas. F., Jr.,
As't R. F. of E.,
Penna. R. R.,
537 S. Graham St.,
E. E., Pittsburgh, Pa.

Mannion, M. F.,
Office Asst. to Chief Engr.,
B. & L. E. R. R.,
96 North High St.,
Greenville, Pa.

Manson, Arthur J.
Asst. Sales Manager,
Westinghouse Electric &
Mfg. Co.,
700 Braddock Ave.,
East Pittsburgh, Pa.

Marquis, George E.,
Train Master,
P. & L. E. R. R. Co.,
702 Sixth Ave.,
New Brighton, Pa.

Marshall, Craig W.,
Eastern Sales Mgr.,
Sunbeam Elec. Mfg. Co.,
1720 Grand Cen. Terminal,
New York, N. Y.

Mason, S. O.,
Foreman,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Masterman, T. W.,
Asst. to Chief Design
Engineer,
Westinghouse Air Brake Co.,
1249 McClure Ave.,
East McKeesport, Pa.

Masters, W. C.,
Technical Adviser, Bolt, Nut
& Rivet Mfg. Ass'n.,
Guardian Bldg.,
Cleveland, Ohio.

Matchneer, Wm. W.,
Sales Engineer,
Buckeye Steel Castings Co.,
Columbus, Ohio.

Matheny, George W.,
Yard Conductor,
P. & L. E. R. R.,
1808 Jenny Lind Ave.,
McKeesport, Pa

Matthews, R. J.,
Salesman,
Edgewater Steel Co.,
P. O. Box 249,
Pittsburgh, Pa.

Mauck, E. A.,
Air Brake Inspector,
Union Railroad,
Box 55,
North Bessemer, Pa.

Maxfield, Col. H. H.,
S. M. P., Southern Div.,
Penna. Railroad,
402 Pennsylvania Bldg.,
Wilmington, Del.

Maxwell, R. E.,
Wheel Engineer,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Mayer, L. I.,
Westinghouse Air Brake Co.,
1228 Fifth Ave.,
East McKeesport, Pa.

Meily, R. P.,
Trans. Mgr., Cent. Dist.,
Westinghouse Electric
& Mfg. Co.,
Gulf Building,
Pittsburgh, Pa.

Meinert, Henry,
Locomotive Inspector,
Montour Railroad,
11 Geneva St.,
Etna, Pa.

Merscher, John,
Foreman Car Repairs,
P. & L. E. R. R.,
348 Woodward Ave.,
McKees Rocks, Pa.

Mertz, G. H.,
Freight Agent., M. C. R. R.,
4035 Murray Ave.,
Pittsburgh, Pa.

Mertz, Jacob J.,
Gang Foreman Car Dept.,
P. & L. E. R. R.,
Main St.,
Glenwillard, Pa.

Micheals, John H.,
Yard Master,
Pennsylvania Railroad,
Freeport, Pa.

Milby, T. A.,
Investigator for the State
Auditor General of Pa.,
220 Shiloh St.,
Mt. Washington,
Pittsburgh, Pa

Millar, Clarence W.,
Mgr. Order Dept.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Miller, J. Alfred,
Gen. Mgr. of Sales,
Vanadium Corp. of America,
P. O. Box 566,
Bridgeville, Pa.

Miller, J. F.,
Sales Engineer,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Miller, John,
Gen. Car Fore., Montour
Railroad,
5127 Blair St.,
Hazelwood, Pa.

Miller, L. L.,
Labor Foreman,
P. & L. E. R. R. Co.,
2900 Merwyn Ave.,
Pittsburgh, Pa.

Miller, R. C.,
General Superintendent,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Mills, C. C.,
President & Gen. Manager,
Unity Railways Co.,
589 Union Trust Bldg.,
Pittsburgh, Pa

Minnick, F. G.,
308 Lincoln Ave.,
Bellevue, Pa.

Misklow, C. J.,
C. C. to Ast. to Train Master,
P. & W. Va. Ry.,
2 McMunn Ave.,
Crafton, Pa.

Misner, George W.,
Westinghouse Air Brake Co.,
304 Arlington Ave.,
East McKeesport, Pa

Mitchell, Frank K.,
240 East End Ave.,
Beaver, Pa.

Mitchell, W. S.,
Signal Inspector,
P. & L. E. R. R.,
540 River Road,
Beaver, Pa.

Mogan, John M.,
Asst. General Yard Master,
P. & L. E. R. R.,
119 Overbrook Blvd.,
Pittsburgh, Pa.

Moir, W. B.,
Chief Car Inspector,
Penna. Railroad,
1009 Penna. Station,
Pittsburgh, Pa.

Molyneaux, Dawes S.,
Sales Engineer,
Ft. Pitt Spring Co.,
Box 917,
Pittsburgh, Pa.

Montague, C. F.,
Supervisor,
Pennsylvania Railroad,
Homestead, Pa.

Montgomery, J. L.,
Assistant Auditor,
Union R. R.,
Frick Bldg. Annex,
Pittsburgh, Pa.

Montgomery, Wm. J.,
Railway Representative,
The Sherwin Williams Co.,
601 Canal Road,
Cleveland, Ohio.

Moore, Donald O.,
Mgr. of Traffic Div.,
Chamber of Commerce,
Chamber of Com. Bldg.,
Pittsburgh, Pa.

Morgan, A. L.,
Supt. on Special Duty,
Penna. R. R. System,
24 Maple Ave.,
Woodlawn,
Wheeling, W. Va.

Morgan, Homer C.,
613 Frederick St.,
McKees Rocks, Pa.

Morris, A. T.,
Plant Manager,
American Chain Co.,
Braddock, Pa.

Morris, J. M.,
President & Gen. Mgr.,
The Lake Terminal
R. R. Co.,
McKeesport Connecting
R. R.,
Frick Bldg.,
Pittsburgh, Pa.

Moses, Graham Lee,
Elec. Engr., Westinghouse
Elec. & Mfg. Co.,
427 South Ave.,
Wilkinsburg, Pa.

Moyer, Oscar G. A.,
Engineer, Rieck-McJunkin
Dairy Co.,
2236 Lutz Ave.,
Mt. Oliver Station,
Pittsburgh, Pa.

Muir, Robert Y.,
Master Car Builder,
P. & W. Va. Ry Co.,
2431 Craftmont Ave.,
Crafton, Pa.

Mulvey, John I.,
Traffic Manager,
Hubbard & Co.,
6301 Butler St.,
Pittsburgh, Pa.

Munn, Alex D.,
First Aid Inspector,
P. & L. E. R. R.,
Box 307,
Glenwillard, Pa.

Murray, Stewart
Salesman,
Joseph Dixon Crucible Co.,
6615 Northumberland St.,
Pittsburgh, Pa.

Muse, Thos. Charles,
Traveling Car Agent,
P. & L. E. R. R.,
253 Fourth St.,
Beaver, Pa.

Mussey, Delavan S.,
Engineer, Development Div.,
Aluminum Co. of America,
Wearever Bldg.,
New Kensington, Pa.

Myers, Arnold,
Railroad Equip't. Inspector,
Carnegie Steel Co.,
217 Woodlawn Ave.,
Homestead, Pa.

Myers, Walter H.,
Chief Clerk to Mech. Supt.,
Montour R. R. Co.,
P. O. Box 161,
West Bridgewater, Pa.

McAbee, W. S.,
Vice Pres. & Gen. Supt.,
Union R. R.,
5239 Gertrude St.,
Pittsburgh, Pa.

McAndrew, R. E.,
General Storekeeper,
B. & L. E. R. R.
Greenville, Pa.

McCarthy, F. W.,
Supt. Road Operation,
Pittsburgh Railways Co.,
435 Sixth Ave.,
Pittsburgh, Pa.

McCartney, John H.,
District Manager,
Gustin-Bacon Mfg. Co.,
1021 Filbert St.,
Philadelphia, Pa.

McCauley, William,
R. F. of E., P. R. R. Co.,
577 Braddock Ave.,
Pittsburgh, Pa.

McClintock, John D.,
Manager, Injector Dept.,
Wm. Sellers & Co., Inc.,
1600 Hamilton St.,
Philadelphia, Pa.

McComb, R. J.,
Sales Manager,
Woodings-Verona Tool Works,
Verona, Pa.

McConnell, Frank P.,
Yard Master,
P. & L. E. R. R.,
2101 ArlingtonAve.,
Pittsburgh, (10) Pa.

McCrea, James G.,
Brakeman,
Pennsylvania Railroad,
611 Pitt St.,
Wilkinsburg, Pa.

McCready, Arthur,
Gang Foreman,
Union Railroad,
821 Eleventh Ave.,
Munhall, Pa.

McCully, D. L.,
Supervisor,
Westinghouse Air Brake Co.,
8001 Westmoreland St.,
Edgewood, Pa.

McCune, J. C.,
Asst. Director Engineering,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

McElravy, J. W.,
Terminal Agent,
P. & L. E. R. R.,
Terminal Annex Bldg.,
S. S., Pittsburgh, Pa.

McFetridge, W. S.,
Principal Asst. Engineer,
B. & L. E. R. R. Co.,
Greenville, Pa.

McGeary, E. J.,
Asst. Superintendent,
B. & L. E. R. R.,
34 Columbia Ave.,
Greenville, Pa.

McGeorge, D. W.,
Secretary,
Edgewater Steel Co.,
P. O. Box 249,
Pittsburgh, Pa.

McGinley, T. A.,
President,
The Duff-Norton Mfg. Co.,
P. O. Box 555,
N. S., Pittsburgh, Pa.

McHugh, C. A.,
Train Master,
P. & W. Va. Ry.,
21 Cannon St.,
Crafton, Pa.

McIlwain, J. P.,
Asst. Mgr.,
Central Warehouse,
P. & L. E. R. R.,
63 Greenbush St.,
Mt. Washington Sta.,
Pittsburgh, Pa.

McIntyre, R. C.,
Master Mechanic,
Union Railroad,
East Pittsburgh, Pa.

McKay, N. H.,
Mang'r., U. S. Chromium Corp'n.,
1100 Pitt St.,
Wilkinsburg, Pa.

McKedy, H. V.,
Rep., Railway Dept.,
The Patterson, Sargent Co.,
135 East 42nd St.,
New York, N. Y.

McKee, Frederick C.,
Pres., Winfield R. R.,
2215 Oliver Bldg.,
Pittsburgh, Pa.

McKee, S. Frank,
Asst. to Gen. Mgr.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

McKenzie, Edward F.,
Signal Instructor,
Pennsylvania Railroad,
7934 Susquehanna St.,
Pittsburgh, Pa.

McKinley, Archie J.,
Chief Motive Power Inspector,
P. & L. E. R. R.,
613 Broadway Ave.,
McKees Rocks, Pa.

McKinley, John T.,
Stenographer,
P. & L. E. R. R.,
403 Woodward Ave.,
McKees Rocks, Pa.

McKinnon, H. D.,
Engineer, Development Div.,
Aluminum Co. of America,
New Kensington, Pa.

McKinstry, C. H.,
Ass't., Research Engineer,
W. A. B. Co.,
46 Sprague St.,
Wilmerding, Pa.

McKinzie, Edward,
General Yard Master,
P. & W. Va. Ry.,
R. D. 8, Crafton, Pa.

McLain, J. E.,
Special Representative,
Bethlehem Steel Co.,
1214 Oliver Bldg.,
Pittsburgh, Pa.

McLaughlin, F. P.,
Gen. Supt.,
Service Stations,
Gulf Refining Co.,
Gulf Bldg.,
Pittsburgh, Pa.

McLaughlin, Howard B.,
R. F. of E.,
P. & L. E. R. R.,
2947 Merwyn Ave.,
Corliss Station,
Pittsburgh, Pa.

McLean, J. L.,
Representative,
Barco Mfg. Co.,
4266 Wooster Road,
Cleveland, Ohio

McMillan, A. P.,
Boiler Foreman,
P. & W. Va. Ry.,
413 E. Main St.,
Carnegie, Pa.

McMillen, Harry,
Car Inspector,
P. & L. E. R. R.,
517 Fourth St.,
Braddock, Pa.

McMullen, Clark E.,
Inspector Transportation,
P. & L. E. R. R. Co.,
P. & L. E. Terminal Bldg.,
Pittsburgh, Pa

McNamee, William W.,
District Manager,
Briggs & Turivas Co.,
41 Marion St.,
Crafton, Pa.

McPherson, A. R.,
Train Master,
Montour Railroad,
1711 State Ave.,
Coraopolis, Pa.

McQuillen, J. J.,
President,
The Durametallic Corp'n.,
Federal Trust Bldg.,
Newark, N. J.

Nagel, James,
Supt. Transportation,
Montour Railroad,
1711 State St.,
Coraopolis, Pa.

Nannah, F. J.,
Engr. Maintenance of Way,
P. & L. E. R. R.,
Pittsburgh, Pa.

Nash, R. L.,
Test Engr., Test Division,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Neff, John P.,
Vice President,
American Arch Co.,
60 E. 42nd St.,
New York, N. Y.

Nethken, H. W.,
Vice President—Traffic,
Pgh. & West Va. R. R.,
405 Wabash Bldg.,
Pittsburgh, Pa.

Newell, J. P., Jr.,
Supervisor Track,
Pennsylvania Railroad,
East Liberty Freight
Station,
Pittsburgh, Pa.

Nieman, Charles J.,
Secretary-Treasurer,
Penn Iron & Steel Co.,
Creighton, Pa.

Nieman, H. L.,
Gang Foreman,
P. & L. E. R. R.,
208 Copeland St.,
McKees Rocks, Pa.

Noble, Jesse A.,
Supv'r Bridges & Bldgs.,
P. & L. E. R. R.,
1643 Broadway,
McKees Rocks, Pa.

Norris, J. L.,
R. F. of E., B. & O. R. R.,
4818 Chatsworth St.,
Pittsburgh, Pa.

Oberlin, A. C.,
Auditor,
Schaefer Equipment Co.,
Koppers Building,
Pittsburgh, Pa.

O'Connor, M. J.,
Rep., Dearborn Chemical Co.,
618 Farmers Bank Bldg.,
Pittsburgh, Pa.

Ogden, F. A., Jr.,
Railway Sales & Traffic,
Pittsburgh Steel
Foundry Corp'n.,
27 Kingston Ave.,
Crafton, Pa.

Ogden, George D.,
Asst. Vice President—Traffic,
Pennsylvania Railroad,
Pennsylvania Station,
New York, N. Y.

O'Leary, Jeremiah J.,
Machinist, Penna. System,
132 Fourth St.,
Oakmont, Pa.

Orbin, George N.,
Retired,
Engineman, B. & O. R. R.,
Box 53,
Dormont, Pittsburgh, Pa.

Orbin, Joseph N.,
District Manager,
Oliver Iron & Steel
Corp.,
10th and Murial Sts.,
Pittsburgh, Pa.

Orchard, Charles,
5849 Hobart St.,
Pittsburgh, Pa.

Orr, D. K.,
Roadmaster,
The Monongahela Ry. Co.,
Brownsville, Pa.

Osborne, Raymond S.,
Mechanical Engineer,
Sewickley, Pa.

O'Sullivan, John J.,
Pipe Fitter, P. & L. E. R. R.,
1130 Wayne Ave.,
McKees Rocks, Pa.

O'Toole, J. L.,
Ass't. to Gen. Manager,
P. & L. E. R. R.,
Pittsburgh, Pa.

Painter, Joseph
Railway Equipment,
134 Vine St.,
Kittanning, Pa.

Paisley, F. R.,
Inspecting Engineer,
P. & L. E. R. R. Co.,
1111 Stanford Road,
N. S., Pittsburgh, Pa.

Palmer, E. A.,
Manager,
Light Traction Sales,
Westinghouse Elec. &
Mfg. Company,
East Pittsburgh, Pa.

Park, Charles L.,
Salesman,
Goodall Rubber Co.,
61 Water St.,
Pittsburgh, Pa.

Paschold, Curtis H.,
Claim Agent,
Legal Dept.,
Penna. R. R.,
417 Chestnut Rd.,
Sewickley, Pa.

Passmore, H. E.,
Representative,
Hanna Stoker Co.,
5668 Darlington Road,
Pittsburgh, Pa.

Patterson, Fred W.,
Consulting Engineer,
1500 Third Ave.,
New Brighton, Pa.

Paul, Lesley C.,
Manager, Publicity Bureau,
W. E. & Mfg. Co.,
217 Woodside Road,
Forest Hills Boro.,
Pittsburgh (21) Pa.

Peabody, Reuben T.,
Railroad Sales Assistant,
Air Reduction Sales Co.,
P. O. Box 307,
Grand Central Sta.,
New York, N. Y.

Pehrson, A. K.,
Mech. Engr.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Penton, John A.,
Pres., The Penton Pub. Co.,
Cleveland, Ohio.

Peoples, James S.,
Freight T. M., P. R. R. Co.,
541 Ridge Ave.,
New Cumberland, Pa.

Peterson, William M.,
Yard Master,
P. & L. E. R. R.,
1404 Pirl St.,
McKeesport, Pa.

Pickard, S. B.,
Chief Electrician,
P. & L. E. R. R.,
R. D. No. 3,
Coraopolis, Pa.

Pillar, Michael,
Piece Work Inspector,
P. & L. E. R. R.,
206 Jane St.,
McKees Rocks, Pa.

Pinkerton, C. J.,
Industrial Sales Manager,
The Watson Standard Co.,
225 Galveston Ave.,
N. S., Pittsburgh, Pa.

Platt, J. G.,
Pres. and Gen. Manager,
Hunt-Spiller Mfg. Corp.,
383 Dorchester Ave.,
So. Boston, Mass.

Pollock, J. H.,
Boiler Foreman,
Montour Railroad,
419 Mill St.,
Coraopolis, Pa.

Pomeroy, William McL.,
General Freight Agent,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Posteraro, S. F.,
Frt. Cashier,
B. & O. R. R.,
Grant and Water Sts.,
Pittsburgh, Pa.

Pringle, Arthur D.,
Supvr. Wage Schedule,
Monongahela Railway,
609 Water St.,
South Brownsville, Pa.

Pringle, H. C.,
Supt., Mon. Con. R. R.,
McCully St. & Marlin Drive,
Mt. Lebanon, Pittsburgh, Pa.

Pringle, J. L.,
Freight Train Master,
Pennsylvania Railroad,
513 Pennsylvania Sta.,
Pittsburgh, Pa.

Pringle, P. V.,
Commercial Engineer,
Westinghouse Air Brake Co.,
811 South Ave.,
Wilkinsburg, Pa.

Provost, S. W.,
Representative,
American Locomotive Co.,
2116 Farmers Bank Bldg.,
Pittsburgh, Pa.

Pugh, Andrew J.,
District Sales Manager,
Homestead Valve Mfg. Co.,
Box "H,"
Coraopolis, Pa.

Purchard, Paul,
Engineer for Auto-Tite Joints Co.,
Park Bldg.,
Pittsburgh, Pa.

Pye, David W.,
President,
Tuco Products Corp.,
30 Church St.,
New York, N. Y.

Queer, Thomas H.,
Sales Engineer,
Pittsburgh Coal Co.,
Oliver Building,
Pittsburgh, Pa.

Ralston, John A.,
Mech. Engr., U. R. R. Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Rambo, Jay B.,
Asst. R. F. of E.,
Pennsylvania Railroad,
Downingtown, Pa.

Rankin, B. B.,
Asst. Gen. Auditor,
P. & L. E. R. R.,
1502 Park Blvd.,
Dormont,
Pittsburgh, Pa.

Rankin, Roy S.,
Dist. Representative,
Hachmeister-Lind Co.,
R. D. No. 2,
Coraopolis Heights,
Coraopolis, Pa.

Raser, Geo. B.,
5614 Walnut St.,
E. E., Pittsburgh, Pa.

Rauschart, E. A.,
Mechanical Supt.,
Montour Railroad,
948 Greenfield Ave.,
Pittsburgh, Pa.

Raymer, I. S.,
Signal Engineer,
P. & L. E. R. R.,
959 Fourth Ave.,
Beaver, Pa.

Ream, A. H.,
S. M. P. & E.,
P. & S. R. R.,
Brookville, Pa.

Record, J. Fred,
Supt. of Production,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Redding, P. E.,
Sales Engineer,
Johns-Manville, Inc.,
Clark Bldg.,
Pittsburgh, Pa.

Redding, R. D.,
General Foreman,
P. & L. E. R. R. Co.,
Campbell, Ohio.

Reeve, George,
Foreman Electrical Dept.,
Ft. Pitt Malleable Iron Co.,
330 Woodward Ave.,
McKees Rocks, Pa.

Regan, W. J.,
Mechanical Engineer,
McConway & Torley
Corp'n.
48th St. & A. V. Ry.,
Pittsburgh, Pa.

Reifsnyder, J. W.,
Engineer of Tests,
Pgh. Testing Laboratory,
P. O. Box 1115,
Pittsburgh, Pa.

Renshaw, W. B.,
Representative,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Reymer, C. H.,
Special Representative,
Oliver Iron & Steel
Corp'n.,
So. 10th & Muriel Sts.,
Pittsburgh, Pa.

Rhine, George B.,
Engine House Foreman,
Pennsylvania Railroad.
Akron, Ohio.

Richardson, E. F.,
Asst. to Engr. of
Motive Power,
B. & L. E. R. R.,
57 Chambers Ave.,
Greenville, Pa.

Richardson, H. R.,
Suprv. of Wage Schedules,
P. & L. E. R. R.,
Pittsburgh, Pa.

Rieker, H. M.,
Freight Agent,
P. & L. E. R. R.,
23rd Street,
S. S., Pittsburgh, Pa.

Rill, John C.,
General Manager,
Pennsylvania Railroad,
Western Region,
Chicago, Ill.

Rizzo, C. M.,
Agent, P. & W. Va. Ry.,
Box 206,
Castle Shannon, Pa.

Robinson, John M.,
Engr., Ry. Engr. Dept.,
Westinghouse Elec. &
Mfg. Co.,
6100 Bryant St.,
Pittsburgh, Pa.

Robinson, R. L.,
Sales Representative,
The American Brake Shoe
& Foundry Co.,
714 Roselawn Ave.,
S. H. B., Pittsburgh, Pa.

Roney, H. E.,
Sig. Matl. Supvr.,
P. & L. E. R. R.,
3111 College Ave.,
Beaver Falls, Pa.

Root, E. E.,
Master Mechanic,
D. L. & W. R. R. Co.,
458 N. Arlington Ave.,
East Orange, N. J.

Rose, A. J.,
Salesman,
Greenville Steel Car Co.,
Greenville, Pa.

Rossell, R. T.,
President, B. & L. E. R. R.,
Union Trust Building,
Pittsburgh, Pa.

Rowles, H. N.,
Asst. Train Master,
Pennsylvania Railroad,
1466 Greenmont Ave.,
South Hills,
Pittsburgh, Pa.

Rudd, W. B.,
General Engineer,
Union Switch & Signal Co.,
Swissvale, Pa.

Rupp, Edwin S.,
C. C. to Div. Accountant,
B. & O. R. R.,
220 Virginia Ave.,
Mt. Washington,
Pittsburgh, Pa.

Rushneck, George L.,
Draftsman,
P. & L. E. R. R.,
McKees Rocks, Pa.

Rutter, Harley E.,
Electrician,
Duquesne Light Co.,
101 Grandview Ave.,
Mt. Washington Sta.,
Pittsburgh, Pa.

Ryan, Frank J.,
District Representative,
Detroit, Toledo & Ironton R. R.,
1106 Clark Bldg.,
Pittsburgh, Pa.

Ryan, James H.,
Mgr., Tank Car Dept.,
Gulf Refining Co.,
734 Clinton Place,
Bellevue, Pa

Saltic, Thomas,
Foreman,
Ft. Pitt Malleable Iron Co.,
321 Russellwood Ave.,
McKees Rocks, Pa.

Sanders, Major Walter C.,
Gen. Mgr., Ry. Div.,
Timken Roller Bearing Co.,
Canton, Ohio.

Sattley, E. C.,
Vice President,
The Champion Sales Co.,
604 Chamber of Commerce Bldg.,
Pittsburgh, Pa

Sauer, George L.,
Freight Agent,
P. & L. E. R. R.,
McKeesport, Pa.

Sawhill, Don M.,
Sawhill Mfg. Co.,
Oliver Bldg.,
Pittsburgh, Pa.

Schadt, Alton D.,
Clerk-Office V. P. & G. M.,
B. & L. E. R. R.,
7338 Whipple St.,
Pittsburgh (18), Pa.

Schaefer, Frederic,
Schaefer Equipment Co.,
Koppers Bldg.,
Pittsburgh, Pa.

Schaeffer, F. E.,
Asst. Manager of Sales,
Union Spring & Mfg. Co.,
2001 Clark Bldg.,
Pittsburgh, Pa.

Schaffer, W. E.,
Back Shop Foreman.
P. & W. Va. Ry.,
242 Boden Ave.,
Carnegie, Pa.

Schaller, Andrew J.,
Asst. Supervisor,
Pennsylvania Railroad,
667 Highland Ave.,
Johnstown, Pa.

Schiller, John,
Cond'r., P. & W. Va. R. R.,
613 Climax St.,
Pittsburgh, (10) Pa.

Schmied, Fred J.,
Foreman,
Railway Service & Supply Corporation,
302 Russellwood Ave.,
McKees Rocks, Pa.

Schmitt, Raymond F.,
Clerk,
Mon. Con. R. R. Co.,
1531 Hoff St.,
N. S., Pittsburgh, Pa.

Schmoll, G. A.,
Supvr. Loco. Maintenance,
B. & O. R. R.,
Baltimore, Md.

Schoch, M. G.,
Asst. Freight Trainmaster,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Schoen, W. H., Jr.,
Vice President,
Pgh. Knife & Forge Co.,
926 Farmers Bank Bldg.,
Pittsburgh, Pa.

Schrader, A. P.,
Asst. to Mgr. Transp'n. Sales,
Westinghouse Elec. & Manufacturing Co.,
East Pittsburgh, Pa.

Schrecongost, C. P.,
Traffic Manager,
Hillman Coal & Coke Co.,
First Nat. Bank Bldg.,
Pittsburgh, Pa.

Schuchman, W. R.,
President,
Homestead Valve Mfg. Co.,
Coraopolis, Pa.

Schultz, Harry P.,
General Yard Master,
P. & L. E. R. R.,
2714 Fifth Ave.,
Beaver Falls, Pa.

Searles, E. J.,
Manager,
Schafer Equipment Co.,
Koppers Bldg.,
Pittsburgh, Pa.

Seibert, Wm. L.,
Engine House Foreman,
P. & L. E. R. R.,
327 Russellwood Ave.,
McKees Rocks, Pa.

Seiss, W. C.,
Car Inspector,
P. C. C. & St. L. Ry. Co.,
507 Justus Avenue,
Carnegie, Pa.

Sekera, Charles J.,
Tester, Engine Dept.,
Westinghouse Air Brake Co.,
437 Short St.,
East McKeesport, Pa.

Semethy, Joseph J.,
Asst. Fore., Dept. D. M.,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Semmer, M. R.,
Salesman,
Air Reduction Sales Co.,
?81 Dixon Ave.,
South Hills Branch,
Pittsburgh, Pa.

Severn, A. B.,
Sales Engineer,
A. Stucki Co.,
419 Oliver Bldg.,
Pittsburgh, Pa.

Shafer, J. S.,
Safety Inspector,
Union Railroad,
Linden Ave.,
East Pittsburgh, Pa.

Shannon, David E.,
Employment Agent,
Ft. Pitt Malleable Iron Co.,
P. O. Box 1054,
Pittsburgh, Pa.

Shaw, George M.,
Sales Engineer,
Standard Steel Car Corp.,
Box 266,
Baltimore, Md.

Sheets, Harry E.,
Traffic Manager,
Montour Railroad,
8 Market St.,
Pittsburgh, Pa.

Shellenbarger, Herbert M.,
Com. Engr., W. A. B. Co.,
184 W. Hutchinson Ave.,
Edgewood, Pa.

Sheridan, Thos. F.,
Asst. to S. M. P. & S. R. S.,
P. & L. E. R. R.,
McKees Rocks. Pa.

Shield, Arthur,
Asst. Auditor Freight Acc'ts,
P. & L. E. R. R.,
1230 Penn Ave.,
New Brighton Pa.

Shirey, Don. B.,
T. M., Union R. R.,
East Pittsburgh, Pa.

Shuck, Wm. C.,
Salesman,
Lockhart Iron & Steel Co.,
P. O. Box 1243,
Pittsburgh, Pa.

Shull, George S.,
President,
Safety First Supply Co.,
Brady Bldg.,
Pittsburgh, Pa.

Sieger, Hillard J.,
Yard Master,
P. & L. E. R. R.,
183 St. Joseph St.,
Mt. Oliver, Pittsburgh, Pa.

Simons, Philip,
Traffic Manager,
Copperweld Steel Co.,
1033 East End Ave.,
Pittsburgh (21), Pa.

Sinclair, I. B.,
Special Agent,
Pennsylvania Railroad,
Pennsylvania Station,
Pittsburgh, Pa.

Siner, Thomas E.,
Camden Forge Co.,
5442 Wayne Ave.,
Germantown,
Philadelphia, Pa.

Sixsmith, G. M.,
Superintendent,
Pennsylvania Railroad,
Room 211, Penna. Station,
Pittsburgh, Pa.

Skellie, W. A.,
Train Master,
B. & L. E. R. R.,
Albion, Pa.

Sladden, F. T.,
A. G. F. A., P. & L. E. R. R.,
Pittsburgh, Pa.

Slick, Frank F.,
Asst. Gen. Supt..
Edgar Thomson Works,
C. S. Co.,
Braddock, Pa.

Smith, Charles F.,
103 Sixth St.,
Pittsburgh, Pa.

Smith, Daniel J.,
Chief Clerk to Vice Pres.,
U. S. Steel Corporation,
Room 1517
71 Broadway,
New York, N. Y.

Smith, E. E.,
General Manager,
Scott Haven Coal Co.,
415 Pitt St.,
Wilkinsburg, Pa.

Smith, E. W.,
Vice President,
Pennsylvania Railroad,
Pennsylvania Station.
Pittsburgh, Pa.

Smith, Frederic M.,
106 Second St.,
Ellwood City, Pa.

Smith, Homer K.,
Railway Engineer,
Westinghouse Elec. &
Mfg. Co.,
1213 La Clair Ave.,
Swissvale, Pa.

Smith, J. Frank,
Gang Foreman,
Union Railroad,
141 Brown Ave.,
Turtle Creek, Pa.

Smith, M. A.,
General Manager,
P. & L. E. R. R.,
Pittsburgh, Pa.

Smith, M. S.,
Storekeeper,
Monongahela Railway Co.,
South Brownsville, Pa.

Smith, Ralph W.,
Sales Engineer,
S. W. Straus & Co.,
600 South 49th St.,
Philadelphia, Pa.

Snitehurst, James G.,
Engine House Foreman ,
Pennsylvania Railroad,
707 Orchard Ave.,
Avalon, Pa.

Snyder, F. I.,
Vice Pres. & General Mgr.,
B. & L. E. R. Co.,
Box 456,
Pittsburgh, Pa.

Snyder, J. C.,
Vice President,
Standard Steel Car Corp.,
Gulf Bldg.,
Pittsburgh, Pa.

Snyder, J. J.,
Coal Freight Agent,
P. & L. E. R. R.,
Pittsburgh, Pa.

Sparks, Hynes,
Sales Department,
The Symington Co.,
230 Park Ave.,
New York, N. Y.

Stackhouse, R. K.,
Gen. Supt. Stations, Transfers,
Penna. R. R.,
1636 Broad St. Station
Building,
Philadelphia, Pa.

Stafford, Samuel G.,
President,
Vulcan Crucible Steel Co.,
Aliquippa, Pa.

Stamets, William K.,
4026 Jenkins Arcade,
Pittsburgh, Pa.

Stamm. B. B.,
Draftsman,
410 McKinley Ave.,
Butler, Pa.

Stark, F. H.,
Retired,
1432 Ridge Ave.,
Coraopolis, Pa.

Stearns, Leo C.,
Car Inspector,
P. & L. E. R. R.,
410 Monongahela Ave.,
Glassport, Pa.

Stearns, W. G.,
Car Inspector,
P. & L. E. R. R.,
1803 Packer St.,
McKeesport, Pa.

Stebler, W. J.,
Vice President,
Pennsylvania Conley Tank
Car Co.,
Koppers Building,
Pittsburgh, Pa.

Stein, J. A.,
Air Brake Instructor,
Pennsylvania Railroad,
Youngwood, Pa.

Stephen, James,
Foreman, Carpenter Shop,
Montour Railroad,
620 Vine St.,
Coraopolis, Pa

Stephenson, G. C.,
Manager,
Koppers Products Co.,
Koppers Bldg.,
Pittsburgh, Pa.

Sterling, C. C.,
Engine House Foreman,
Union R. R.,
339 Albert St.,
Turtle Creek, Pa.

Stevens, L. V.,
President,
Fort Pitt Stoker Co.,
35 Water St.,
Pittsburgh, Pa.

Stewart, K. C.,
Chief Engineer,
Canton Car Co.,
214 American Ave.,
Butler, Pa.

Stewart, L. R.,
Asst. Supt., Labor & Wages,
Pennsylvania Railroad,
720 Pennsylvania Staion,
Pittsburgh, Pa.

Stiles, Lawson A.,
Baggage Agent,
P. & L. E. R. R.,
P. & L. E. Terminal,
Pittsburgh, Pa.

Stillwagon, Charles K.,
Superintendent,
Davis Brake Beam Co.,
R. D. 5, Box 67,
Johnstown, Pa.

Stine, D. H.,
Asst. R. F. of E.,
Pennsylvania Railroad,
Allegheny Shops,
N. S., Pittsburgh, Pa.

Stiver, Joseph R.,
Conductor,
B. R. & P. Ry.,
104 Cypress St.,
Punxsutawney, Pa.

Stoecker, P. J.,
Pittsburgh Steel Co.,
Union Trust Bldg.,
Pittsburgh, Pa.

Stoffregen, Louis E.,
Draftsman,
P. & L. E. R. R.,
804 Southern Ave.,
Mt. Washington,
Pittsburgh, Pa.

Storer, N. W.,
Consulting Rwy. Engineer,
Westinghouse Elec. &
Manufacturing Co.,
East Pittsburgh, Pa.

Stritzinger, Frank,
Wheel Insp'r., P. & L. E. R. R.,
117 Stem St.,
Wabash Station,
Pittsburgh, Pa.

Stucki, A.,
Engineer,
419 Oliver Bldg.,
Pittsburgh, Pa.

Stuebing, A. F.,
Scarsdale, N. Y.

Suckfield, G. A.,
Asst. Chief Engr., F. C. D.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Sullivan, Ambrose W.,
Sales Agent,
American Locomotive Co.,
Plaza Bldg.,
Pittsburgh, Pa.

Sullivan, J. C.,
Gen. Supt., Tank Car Dept.,
Gulf Refining Co.,
Gulf Building,
Pittsburgh, Pa.

Sullivan, P. W.,
Asst. To Gen. Mgr.,
Pennsylvania Railroad,
Pennsylvania Sta.,
Pittsburgh, Pa.

Sutherland, Lloyd,
Gen. Storekeeper,
P. & L. E. R. R.,
124 Greydon Ave.,
McKees Rocks, Pa.

Suydam, R. S.,
President,
M. B. Suydam Co.,
Island & Preble Aves.,
N. S., Pittsburgh, Pa

Swanson, Carl A.,
C. C. to Gen. Mgr.,
P. & L. E. R. R.,
468 Irvin Ave.,
Rochester, Pa.

Swope, Bruce M.,
Supt. Motive Power,
Pennsylvania Railroad,
132 Emerson Ave.,
Aspinwall, Pa.

Sykes, Arthur H.,
Asst. Baggage Agent,
P. & L. E. R. R.,
707 Florida Ave.,
Mt. Lebanon,
Pittsburgh, Pa.

Symons, F. E.,
President,
The Ralston Steel Car Co.,
Columbus, Ohio

Tarr, H. S.,
Foreman,
Union Railroad,
516 North Ave.,
Wilkinsburg, Pa.

Tate, James B.,
Purchasing Agent
Pressed Steel Car Co.,
McKees Rocks, Pa.

Tate, M. K.,
Manager of Service,
Lima Locomotive Works,
Inc.,
Lima, Ohio

Taylor, H. G.,
Pres., Ball Chemical Co.,
Fulton Bldg.,
Pittsburgh, Pa.

Taylor, Joseph M.,
Asst. to President,
Ball Chemical Co.,
1201 Fulton Bldg.,
Pittsburgh, Pa.

Taylor, Leonard C. G.,
Car Inspector,
Penna. Railroad,
1901 Marmaduke St.,
N. S., Pittsburgh, Pa.

Temple, H. H.,
C. Engr., P. & W. Va. Ry.,
Wabash Bldg.,
Pittsburgh, Pa.

Thomas, Frank B.,
Chief General Engineer,
W. A. B. Co.,
2 Newport Road,
Forest Hills,
Wilkinsburg, Pa.

Thomas, George P.,
President,
Thomas Spacing Machine
Co.,
Glenshaw, Pa.

Thomas, Harold N.,
Inspector,
Carnegie Steel Co.,
5908 Rural St.,
Pittsburgh, Pa.

Thomas, T. T.,
Foreman,
Union Railroad Co.,
422 Albert St.,
Turtle Creek, Pa.

Thompson, Harry T.,
District Manager,
Thermit Department,
Metal & Thermit Corp.,
1514 North Ave., West,
N. S., Pittsburgh, Pa.

Thompson, Howard A.,
General Engineer,
Union Swith & Signal Co.,
311 W. Swissvale Ave.,
Edgewood,
Swissvale P. O., Pa.

Thornton, A. W.,
Resident Engineer,
P. & L. E. R. R.,
Terminal Bldg.,
Pittsburgh, Pa.

Tipton, George M.,
Agent, B. & O. R. R.,
Braddock, Pa.

Tomasic, Joseph D.,
Machinist,
Pennsylvania Railroad,
505 Greensburg Pike,
Turtle Creek, Pa.

Tomasic, Nicholas M., Jr.,
Locomotive Mechanic,
Pennsylvania Railroad.
412 Tintsman St.,
Turtle Creek, Pa.

Touceda, Prof. Enrique,
Consulting Engineer,
943 Broadway,
Albany, N. Y.

Toussaint, R.,
Chief of Police,
P. & L. E. R. R.,
Pittsburgh, Pa.

Tovey, G. F.,
Asst. Train Master,
Aliquippa & Southern R. R.,
1213 Boundry St.,
Aliquippa, Pa.

Trainer, M. N.,
Vice President,
American Brake Shoe & Fdy. Company,
230 Park Ave.,
New York, N. Y.

Trautman, Harry J.,
Yard Superintendent,
Briggs & Turivas,
R. D. No. 2,
Coraopolis, Pa.

Trax, Louis R.,
Inspector,
Union Railroad,
520 James St.,
Turtle Creek, Pa.

Triem, W. R.,
Supt., Monongahela Div.,
Pennsylvania Railroad,
206 Pennsylvania Station,
Pittsburgh, Pa.

Trust, C. W.,
Asst. Traffic Mgr.,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Tucker, Jas W.,
Division Storekeeper,
B. & O. R. R.,
Box 166,
Chillicothe, Ohio

Tucker, John L.,
"Retired" Trainmaster,
Pennsylvania Railroad,
5512 Center Ave.,
Pittsburgh, Pa.

Turner, F. M.,
General Superintendent,
A. & S. S. R. R. Co.,
Cor. 10th and Muriel Sts.,
S. S., Pittsburgh, Pa.

Tuttle, C. L.,
Mech. Engr., B. & L. E. R. R.,
15 Shady Ave.,
Greenville, Pa.

Tyrie, Robert M.,
Loco. Engineer,
Montour Railroad,
815 Ferree St.,
Coraopolis, Pa.

Uhar, John J.,
Auditor,
Penn Iron & Steel Co.,
Creighton, Pa.

Unger, Dr. J. S.,
Manager, Central Research,
Bureau, Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Urtel, E. J.,
Asst. Division Storekeeper,
B. & O. R. R.,
3936 Dalewood Ave.,
Brentwood, Pa.

Van Blarcom, Warren C.,
Supt., Aliquippa &
Southern R. R.,
Aliquippa, Pa.

Van Horn, I. L.,
Sales Rep.,
Ferbert-Schorndorfer Co.,
2426 Dover Center Rd.,
Dover Center, Ohio

Van Vranken, S. E.,
Secretary-Treasurer,
Pgh. Cleanser Laboratory,
261 N. Balph Ave.,
Bellevue, Pa.

Vollmer, Karl L.,
Asst. Steam Engineer,
Spang-Chalfant Co.,
106 W. Undercliff St.,
Etna, Pa.

Wallace, W. E.,
Section Foreman,
P. & L. E. R. R.,
452 Motheral Ave.,
Monessen, Pa

Walther, G. C.,
Foreman,
Penna. Railroad,
877 Second St.,
Verona, Pa.

Warfel, J. A.,
Dist. Manager,
Air Reduction Sales Co.,
1116 Ridge Ave.,
N. S., Pittsburgh, Pa.

Wark, J. M.,
Foreman,
Pennsylvania Railroad,
828 E. Hutchinson Ave.,
Swissvale Branch,
Pittsburgh, Pa.

Warner, E. O.,
District Sales Manager,
National Malleable &
Steel Castings Co.,
Insurance Co. of N.
America Bldg.,
Philadelphia, Pa.

Waterman, Edwin H.,
Car Foreman, Union R. R.,
Monongahela Jct. Shop,
East Pittsburgh, Pa.

Watkins, T. A.,
Insurance Inspector,
Pgh Coal Co.—Montour
Railroad,
3835 Hiawatha St.,
N. S., Pittsburgh, Pa.

Watt, Herbert J.,
Mgr. of Sales Ry. Materials,
Jones & Laughlin Steel
Corporation,
Third and Ross Sts.,
Pittsburgh, Pa.

Weaver, J. E.,
Car Dispatcher,
Gulf Refining Co.,
Gulf Building,
Pittsburgh, Pa.

Weaver, W. Frank,
Storekeeper,
The Pullman Co.,
723 Singer Place,
Wilkinsburg Branch,
Pittsburgh, Pa.

Weber, Robert J.,
Special Representative,
Westinghouse Electric
& Mfg. Co.,
Gulf Building,
Pittsburgh, Pa.

Webster, H. D.,
392 S. Main St.,
Greenville, Pa.

Weiler, Paul,
District Manager,
Franklin Railway Supply
Co., Inc.,
68 W. Fourth St.,
Dunkirk, N. Y.

Welch, E. M.,
Chemical Engineer,
Dearborn Chemical Co.,
2615 Mackinaw Ave.,
Pittsburgh, Pa.

Wendt, Edwin F.,
Consulting Engr.,
Union Trust Bldg.,
Washington, D. C.

West, Troy,
Draftsman,
Union Railroad Co.,
1400 Center St.,
Wilkinsburg, Pa.

West, W. C.,
Railroad Division,
Standard Oil Co. of Pa.,
Public Ledger Bldg.,
Philadelphia, Pa.

West, Geo. S.,
Division Superintendent,
Pennsylvania Railroad,
Wilmington, Del.

Whalen, Daniel J.,
General Manager,
The Canton Car Co.,
Canton, Ohio

Wheatley, Wm.,
Inspector,
Ft. Pitt Malleable Iron Co.,
1113 Dohrman St.,
McKees Rocks, Pa.

Wheeler, Charles M.,
Sales Engineer,
Union Switch & Signal Co.,
Swissvale, Pa.

Whipple, A. L.,
District Sales Manager,
Standard Stoker Co., Inc.,
350 Madison Ave.,
New York City

White, Charles G.,
Supervisor,
Aliquippa & Southern R. R.,
193 Clay St.,
Rochester, Pa.

White, Herbert A.,
Sales Mgr., Pgh. Dist.,
National Bearing
Metals Corp.,
928 Shore Ave.,
N. S., Pittsburgh, Pa.

White, J. C.,
Superintendent,
Pennsylvania Railroad,
32nd & Powelton Ave.,
Philadelphia, Pa.

Whitmore, John G.,
Division Counsel,
B. & O. R. R. Co.,
Ridgway, Pa.

Whitridge, J. C.,
President & General Mgr.,
The Buckeye Steel Castings
Company,
Columbus, Ohio

Wholey, V. A.,
Gen. Traffic Mgr.
P. & W. Va. Ry.,
Wabash Bldg.,
Pittsburgh, Pa.

Wikander, Oscar R.,
Mechanical Engineer,
Ring Spring Dept.,
Edgewater Steel Co.,
900 South Negley Ave.,
Pittsburgh, Pa.

Wilcox, H. C.,
Associate Editor,
Railway Mechanical
Engineer,
30 Church St.,
New York, N. Y.

Wildin, G. W.,
Consulting Engineer,
Westinghouse Air Brake
Company,
Westinghouse Bldg.,
Pittsburgh, Pa.

Wilharm, John H.,
Traffic Manager,
Diamond Alkali Co.,
436 Seventh Ave.,
Pittsburgh, Pa.

Wilkinson, F. C.,
Division Superintendent,
Penna. Railroad,
2509 E. Broadway,
Cass
Logansport, Ind.

Williamson, A. G.,
Union Switch & Signal Co.,
721 Washington Ave.,
Carnegie, Pa.

Wilson, James M.,
Sales Engineer,
Metal & Thermit Corp'n.,
2961 Stafford St.,
Corliss Station,
Pittsburgh, Pa.

Winslow, Geo. S.,
Manager,
Ingersoll-Rand Co.,
Chamber of Commerce
Building,
Pittsburgh, Pa.

Winslow, Sidney H.,
Service Engineer,
Franklin Rwy. Supply Co.,
1105 Biltmore Ave.,
S. H. B., Pittsburgh, Pa.

Winter, P. S.,
Master Car Builder,
B. & L. E. R. R.,
42 First Ave.,
Greenville, Pa.

Withrow, R. C.,
Sales Engineer,
Freedom Oil Works Co.,
Brighton Heights,
New Brighton, Pa.

Wittman, Edward A.,
Loco. Boiler Inspector,
Montour Railroad,
606½ Mansfield Ave.,
West End, Pittsburgh, Pa.

Wood, John H.,
Telegraph Operator,
P. & L. E. R. R.,
1321 Merrick Ave.,
Brookline,
Pitsburgh, Pa.

Woodward, Robert,
Machinist, P. R. R. System,
314 George St.,
Turtle Creek, Pa.

Woollen, A. H.,
Engineer,
Development Division,
Aluminum Company of
America,
New Kensington, Pa.

Wright, C. W.,
Vice President,
Standard Steel Car
Corp'n.,
Gulf Bldg.,
Pittsburgh, Pa.

Wright, E. W.,
Asst. to President,
Ft. Pitt Malleable Iron Co.,
5442 Baywood St.,
Pittsburgh, Pa.

Wright, John B.,
Assistant Vice President,
W. A. B. Co.,
Wilmerding, Pa.

Wright, O. L.,
421 Chestnut St.,
Philadelphia, Pa.

Wright, R. V.,
Managing Editor,
Railway Age,
30 Church St.,
New York, N. Y.

Wurts, T. C.,
Heavy Traction Section Head,
Westinghouse Elec. &
Mfg. Co.,
East Pittsburgh, Pa.

Wyke, J. W.,
Traveling Engineer,
Union Railroad,
East Pittsburgh, Pa.

Wynne, F. E.,
Asst. Gen'l. Manager,
Ry. Engr'g. Dept.,
Westinghouse Elec.
& Mfg. Co.,
East Pittsburgh, Pa.

Yarnall, Jesse,
Asst. Yard Master,
Pennsylvania Railroad,
123 Race St.,
Edgewood, Pa.

Yohe, C. M.,
Vice President,
P. & L. E. R. R.,
Pittsburgh, Pa.

Young, F. C.,
Credit Manager,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Zammikiel, John
Clerk,
Union Railroad Co.,
413 Boyd St.,
Turtle Creek, Pa.

Zirckel, Arthur E.,
Asst. Traffic Manager,
Pittsburgh Steel Co.,
700 Union Trust Bldg.,
Pittsburgh, Pa.

Zitzman, N. E.,
Chief Clerk to S. F. T.,
P. & L. E. R. R.,
Terminal Bldg.,
Pittsburgh, Pa.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

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STATE OF PENNSYLVANIA }
COUNTY OF ALLEGHENY } ss:

Before me, a Notary Public in and for the State and county aforesaid, personally appeared J. D. Conway, Secretary, who having been duly sworn according to law, deposes and says that he is the Editor and Publisher, of the Official Proceedings—Railway Club of Pittsburgh.

Publisher Official Proceedings—Railway Club of Pittsburgh.

Editor, J. D. Conway, 515 Grandview Avenue, Pittsburgh, Pa., (19th Ward.)

Managing Editor, J. D. Conway, 515 Grandview Avenue, Pittsburgh, Pa., (19th Ward.)

Business Manager, J. D. Conway, 515 Grandview Avenue, Pittsburgh, Pa., (19th Ward.)

The Official Proceedings—The Railway Club of Pittsburgh.

President, F. I. Snyder, Pittsburgh, Pa.

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Sworn to and subscribed before me this 28th day of September, 1933.

(Seal) AGNES B. SHAW, Notary Public.
(My commission expires March 9, 1935.)

2.